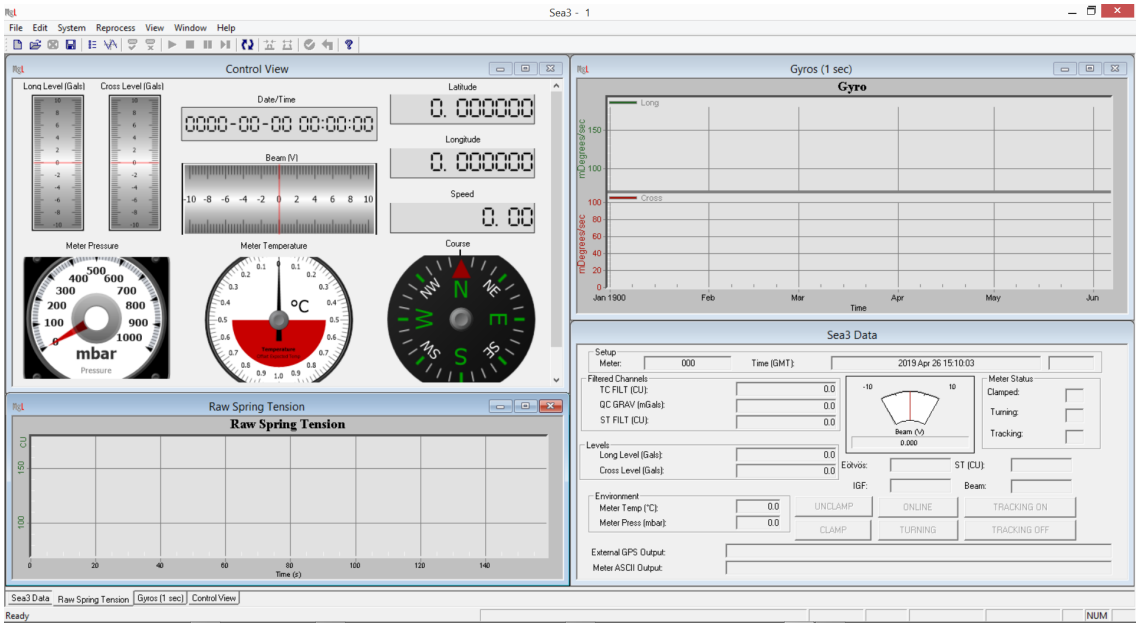
Release 115-781-002A, 16 Feb 2022

Sea3

Processing Software Manual



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Applicable Products
Sea System III Marine Gravity Meter

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1. INTRODUCTION

This is the operator's manual for the Micro-g LaCoste Sea3 PiperPro Processing Software. The software provides sophisticated data collection and processing. It also has analysis capabilities, including the standard environmental gravity corrections to help achieve mGal level gravity measurements.

For operation of the Sea3 gravity meter hardware, refer to the appropriate hardware user's manual.

System Requirements

PiperPro runs on any computer with the following minimal standards:

Operating System:	Vista, Windows 7, Windows 8.1, Windows 10
Free Hard Drive Space:	1 GB or greater
RAM:	2 GB or greater
Processor:	Intel™ P3 or greater (AMD also works with similar standards)
Processing Speed:	1 GHz or greater

Conventions

Dialog box menus, commands, dialog box titles, labels and options are bolded text in the user instructions. WARNING and IMPORTANT notes are highlighted in red.

2. INSTALLATION

Sea3 PiperPro Software

Licensed users of Sea3 PiperPro can download the latest Sea3 PiperPro software (Sea3_yy-mm-dd_hhmmAM/PM_installer.exe) from:

http://www.microglacoste.com/Sea3/

After installation, check that the files listed in Table 2-1 are present on the local machine. If you do not have all the listed files and/or directories once PiperPro is installed, please contact Micro-g LaCoste.

Table 2-1 Installation Files

Filename	Description
Program Files\PiperPro\readme.txt	Overview of installation procedures.
Program Files\PiperPro\Sea3Help.pdf	This document.
Program Files\PiperPro\bin\Sea3_yy-mm-dd_hhmmAM/PM.exe	Main application.
gInfo\PiperProDisplay.ini	Configuration information for PiperPro.exe.
Program Files\PiperPro\License.txt	Standard software licensing information.

Installation Procedure

NOTE Before beginning installation, be sure to uninstall any previous version of Sea3 PiperPro.

- Double click the Install application (Sea3_yy-mm-dd_hhmmAM/PM_installer.exe).
  - Follow the displayed instructions.
  - It is highly recommended that you accept ALL default settings.
- Double click on the newly installed Sea3 PiperPro program icon.
- Select “generate” when prompted.
  - This creates a SysChk.bin file that is unique to this computer.
  - Note where it is located on your local hard drive.
  - Email this SysChk.bin to: support@microglacoste.com

- Wait for us to send you PiperProPWinfo.bin. This usually takes less than 24 hours during a normal business week.

NOTE The SysChk.bin files are unique for each computer, so please send one file at a time.

- Upon receipt of PiperProPWInfo.bin, manually copy the file into the newly created gInfo. (Usually c:\gInfo).
- Double click on the Sea3 PiperPro program icon.
  - Select **Install.** (May not be required if password is recognized automatically)
  - You may be asked to point to the PiperProPWInfo.bin file on your local hard drive.

IMPORTANT Due to details in the software protection of Sea3 PiperPro, if at any time the user adds or removes hardware from the computer, it may be necessary to obtain a new password file by following the above steps.

- Next, create the directory c:\gData\PiperPro if it does not already exist.
  - This is the default location for all Sea3 PiperPro data.

You are now ready to run Sea3 PiperPro.

3. SYSTEM SETTINGS

Local Configuration File

Local .ini File

All processing parameters for the loaded data are stored in the local PiperPro.ini file located in the same folder as the data. Changes to this .ini file only affect the data in that folder when reprocessed.

NOTE To save the processing parameters changes to the PiperPro.ini file, select **Save** from the **File** menu. Note that the settings are automatically saved when processing starts (Select **Start** from the **Reprocess** menu).

Modify System Setting Parameters

The processing parameters may be modified from the **System** menu and clicking **Settings** (or **F3**). There are three tab pages (Setup, Calibration and Corrections) contained in the **System Settings** dialog.

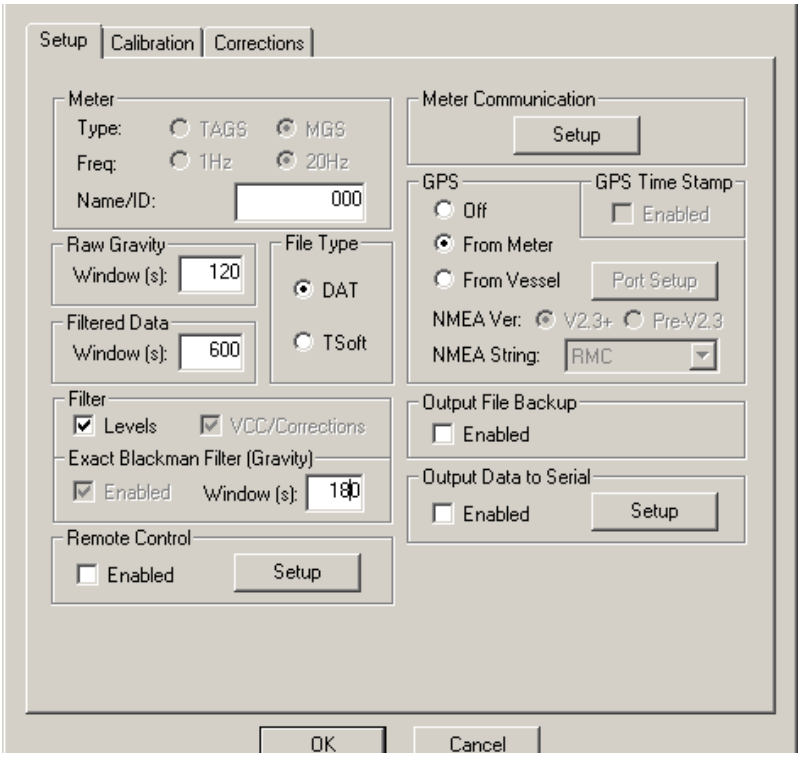

Figure 3-1 System Settings Dialog: Setup Tab Page

Setup Tab

The **Setup** tab page configures the instrument setup parameters. Refer to Table 3-1 for a description of each of the setup parameters. Figure 3-1 shows the **Setup** tab page.

Table 3-1 System Settings Dialog: Setup Tab Page Parameters and Descriptions

Section	Parameter	Description
Meter	Name/ID	Serial number of the meter.
Raw Gravity	Window(s)	Total seconds plotted for raw gravity. After this total has been reached, graphs scroll horizontally.
Filtered Data	Window(s)	Total seconds plotted for one second data plots. After this total has been reached, graphs scroll horizontally.
Filter	Levels	Checking the **Levels** box enables a 20Hz (for both MGS-6 and TAGS-6 meter) to 5 second filter on the levels data. If this is disabled, the levels are filtered to 1 Hz data instead. (This is only a graphical filter. This filter is not applied to recorded data in files.
	Exact Blackman Filter (Gravity)	Checking the **Exact Blackman Filter (Gravity)** box enables a FIR (Finite Impulse Response) Exact Blackman filter on the 1 Hz gravity data. Refer to Appendix B for the QC filter computation.
	Window (s)	The window text field is the filter length for the Exact Blackman Filter.
File type	DAT or TSoft	Select the output file type. The DAT files are comma delimited ASCII files that can be read using a spreadsheet application. TSoft files are tab delimited files, with detailed header and can be imported into the TSoft reprocessing software.
Meter Communication	Setup	Click the Setup button to configure communication settings.
GPS	Off	If no GPS is connected.
	From Meter	Meter connected to GPS.
	From Vessel	System computer connected to serial GPS. Click **Port Setup** button to configure communication settings
GPS Time Stamp	Grayed out for Sea 3 systems	Not applicable for Sea 3 systems
Output file Backup	Enabled	Click **Enabled** to send the backup file to another location.
Output Data to Serial	Enable	Click Enabled to send data to an external location through the serial port. Click the Setup button to configure communication settings and data format. Refer to the Serial Output Section for additional information.

Serial Output Setup

Under the **System** menu select the **System Settings** option to access the **Setup** tab page where data can be configured to be sent to an external location. In the **Output Data to Serial** section, click **Enable** then click **Setup** to access the **Serial Output Setup** dialog (Figure 3-2). Refer to Table 3-2 for a description of each of the output options.

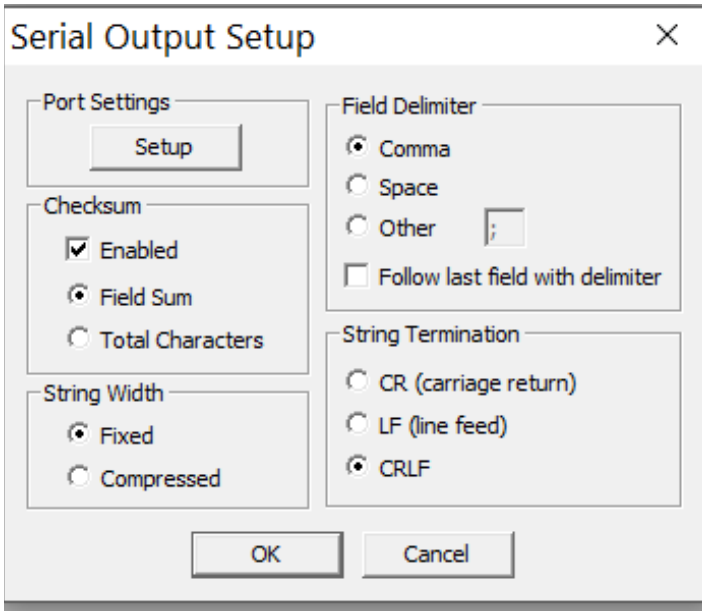

Figure 3-2 Serial Output Setup Dialog

Table 3-2 Serial Output Setup Table Description

Option	Description
Port Settings	Click **Setup** and configure the port settings.
Checksum	Choose a checksum option.
String Width	Choose a string width.
Field Delimiter	Choose a field delimiter.
String Termination	Choose a string termination.

Calibration Tab

The **Calibration** tab page shows the current calibration of the meter. The calibration factors change if the meter is serviced and/or altered. Figure 3-3 shows the **Calibration** tab page. The calibration parameters are described in Table 3-3.

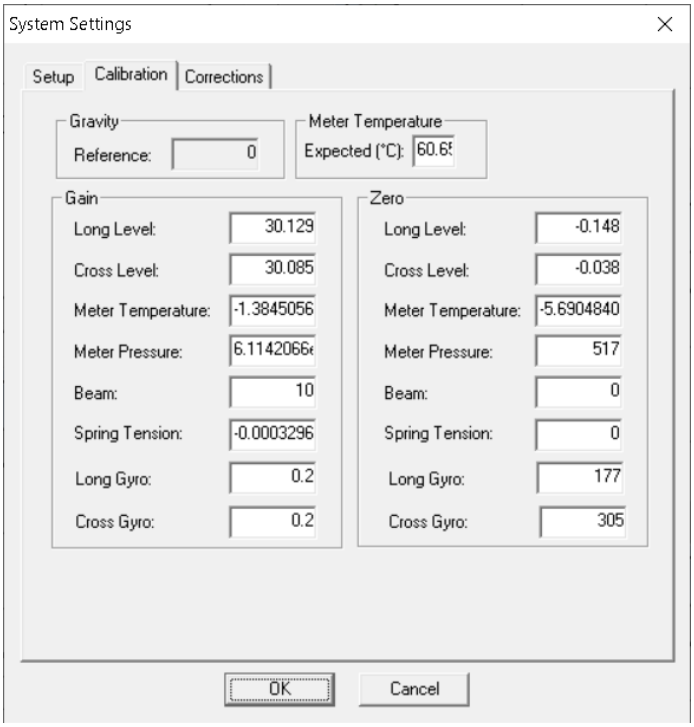

Figure 3-3 System Settings Dialog: Calibration Tab Page

Table 3-3 System Settings Dialog: Calibration Tab Page Parameters and Descriptions

Section	Parameter	Description
Gravity	Reference	This is an offset for gravity. Add the absolute value here for your location to offset the incoming gravity. This is required for IGF correction.
Meter Temperature	Expected (°C)	The expected meter temperature for the current instrument. If the meter temperature is not within ± ½ degree C, then a warning pops up during data acquisition.
Gain / Zero	Long/Cross Level Meter Temperature Meter Pressure Beam Spring Tension Long/Cross Gyros	These are the calibration factors used to convert the raw input values into their correct units.

Corrections Tab

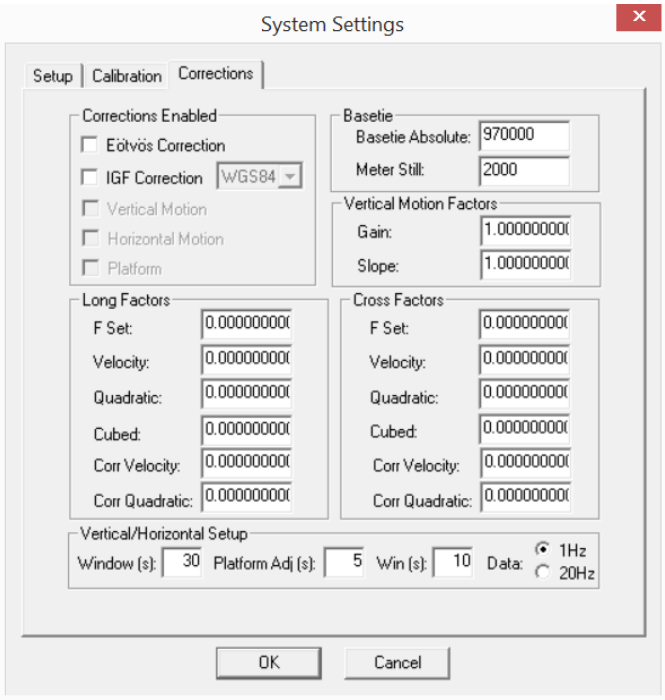

Figure 3-4 System Settings Dialog: Corrections Tab Page

Use the **Corrections** Tab page to enable Eötvös and/or IGF (International Gravity Formula, GRS80) correction and set the value of gravity reference (Base tie). Figure 3-4 shows the **Corrections** tab page. The other fields are used for experimental purposes.

Eötvös Correction

Eötvös correction in milliGal:

$$E_{corr} = 7.503\ v \cos \lambda \sin \alpha + 0.004154v^2$$

Where:
v = ship's speed in knots
λ= latitude
α= ship's course heading (0° is due north, 90° is due east)

IGF Correction

International Gravity Formula, GRS80:

$$g = 978032.67715 \frac{1 + 0.001931851353 \sin^2 \lambda}{\sqrt{1 - 0.00669438002290 \sin^2 \lambda}}$$

λ = latitude
g is in milliGal

4. SEA3 MAIN WINDOW AND VIEWS

Sea3 Main Window

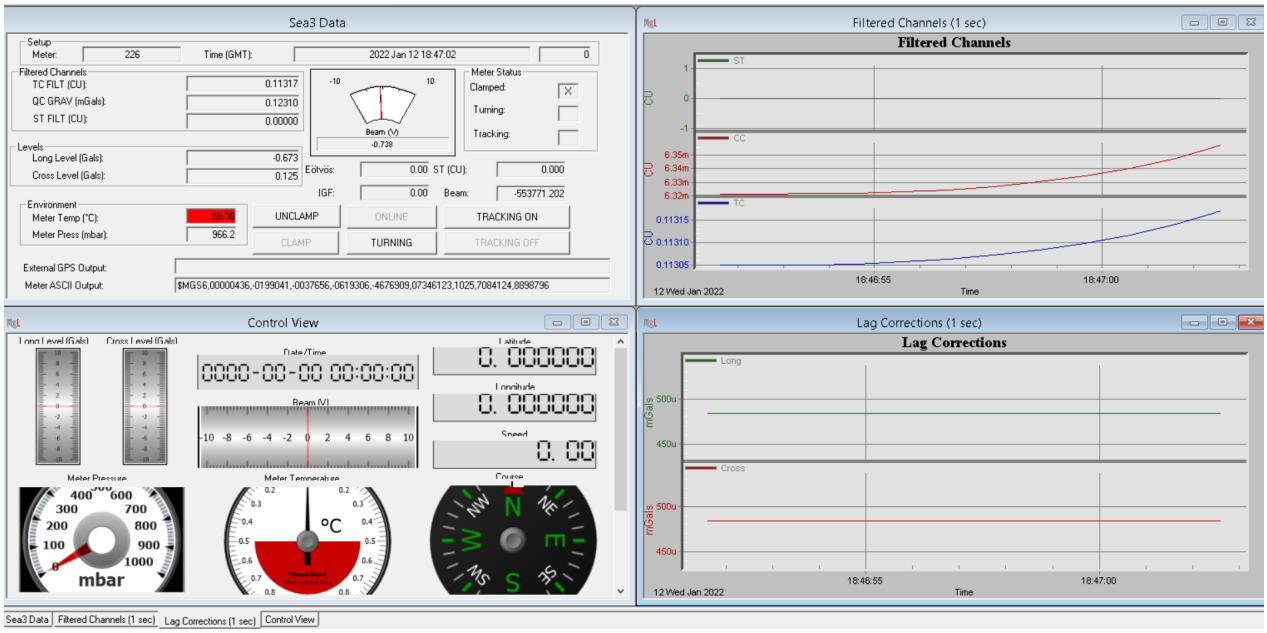

Figure 4-1 Example Sea3 Main Window with Several Views Selected

The main **Sea3** window (Figure 4-1) always displays the **Sea3 Data** view (Figure 4-2). It is the main view used to convey meter status and cannot be closed.

There are thirteen other selectable views available to the user:

- Filtered Gravity
- Environment
- Gyros
- Levels
- Corrections
- Platform Corrections
- Raw Spring Tension
- Raw Beam
- Filtered Channels
- Lag corrections
- Controls
- Navigation Plot
- Raw Serial Output

Under the **View** menu, click on the desired view to toggle the view On/Off. Figure 4-1 shows an example setup of the Sea3 main window with several views selected.

Sea3's main window remembers and displays the last selected views and their positions.

Use the **Window** menu, to choose **Cascade** or **Tile** layout style.

Sea3 Data View

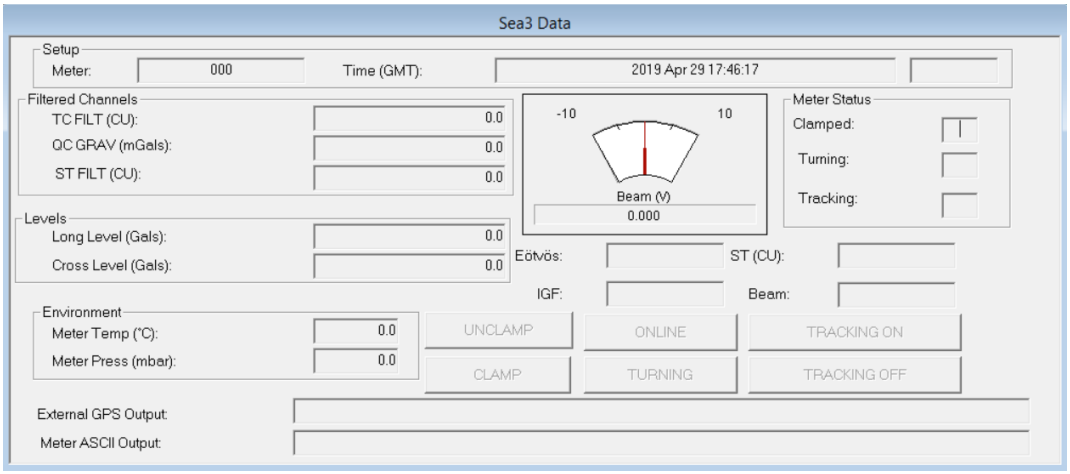

Figure 4-2 Sea3 Data View

Figure 4-2 shows an example of the **Sea3 Data** view. Refer to Table 4-1 for description of the **Sea3 Data** view parameters.

Table 4-1 Parameter Description of Sea3 Data View

Section	Parameter	Description
Setup	Meter Time (GMT)	Shows the meter number and the current time (GMT).
Filtered Channels	Filtered TC (CU) Filtered QC Grav (mGals) Filtered ST (CU)	Provides information about the current filtered total correction, quality control gravity, and filtered spring tension
Levels	Long Level Cross Level	Displays the current long and cross level position values.
Environment	Meter Temp (°C) Meter Press (mbar)	Shows the current meter temperature and pressure.
Meter ASCII Output	Meter ASCII Output	Displays the raw serial string acquired from the meter.

External GPS Output	External GPS Output	Displays the raw gps string acquired from an external gps source
Meter Status	Meter Status	This displays meter status information: Clamped, Turning, and Tracking
	ONLINE TURNING UNCLAMP CLAMP TRACKING ON TRACKING OFF	Use the system buttons to communicate with the meter. The meter can be placed in TURNING or ONLINE mode or the operator can CLAMP or UNCLAMP the meter.
	Beam	The current beam position is given and shown on the dial.
	Eötvös	The Eötvös correction.
	ST (CU)	Spring Tension in counter units
	IGF	The IGF correction.

Filtered Gravity View

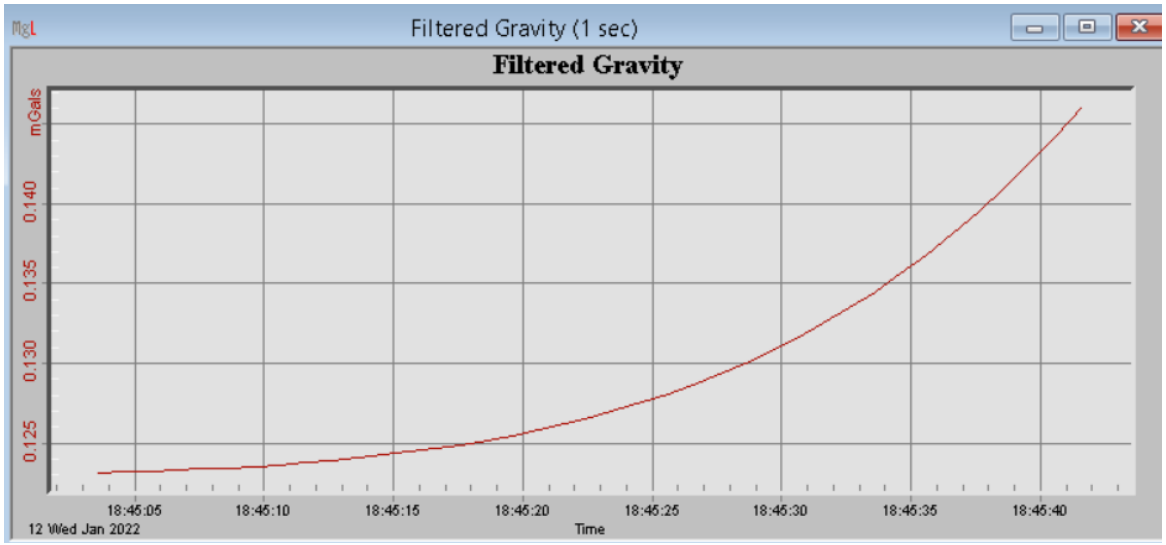

Figure 4-3 Filtered Gravity View

The **Filtered Gravity** view (Figure 4-3) displays the corrected gravity data. The graph automatically resizes to fit all the data across the graph. The data fit time range is set in the **Window (s)** parameter in the **Filtered Data** section on the **Setup** tab page in the **System Settings** dialog. Click **Settings** under the **System** menu. The graph scrolls when the data exceeds the set range.

Environment View

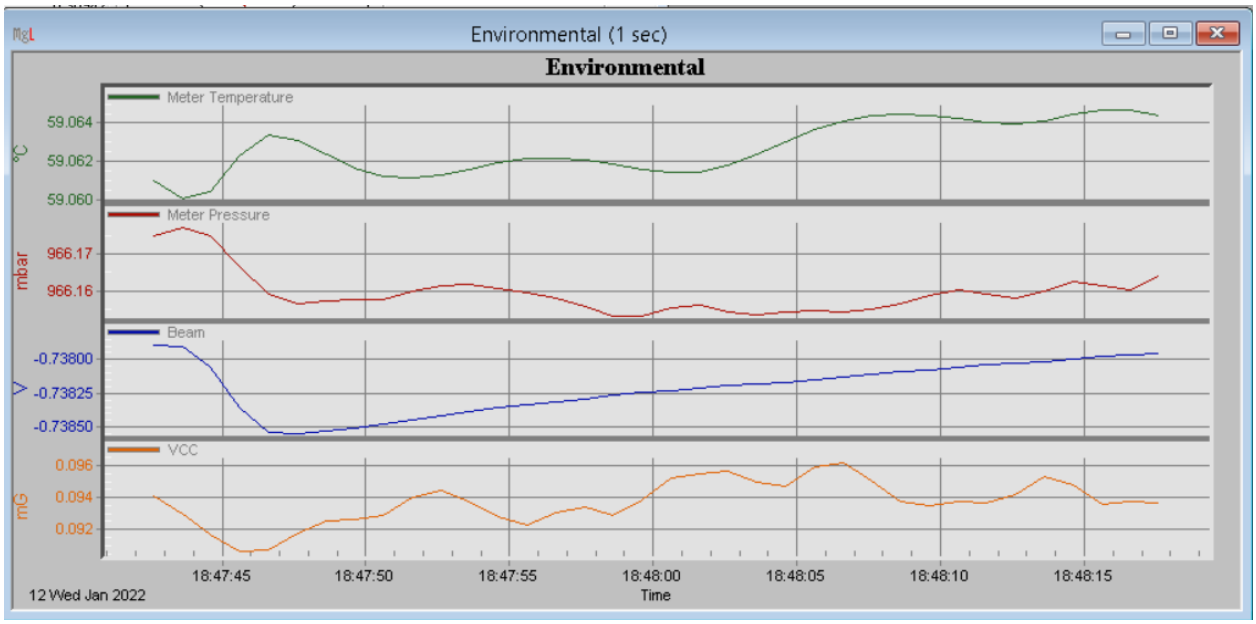

Figure 4-4 Environment View

The **Environment** view (Figure 4-4) displays the environmental data received from the meter, which includes meter temperature and pressure, beam position and VCC calculations.

The data fit time range is set in the **Filtered Data Window (s)** parameter on the **Setup** tab page of the **System Settings** dialog. Click **Settings** under the **System** menu.

Levels View

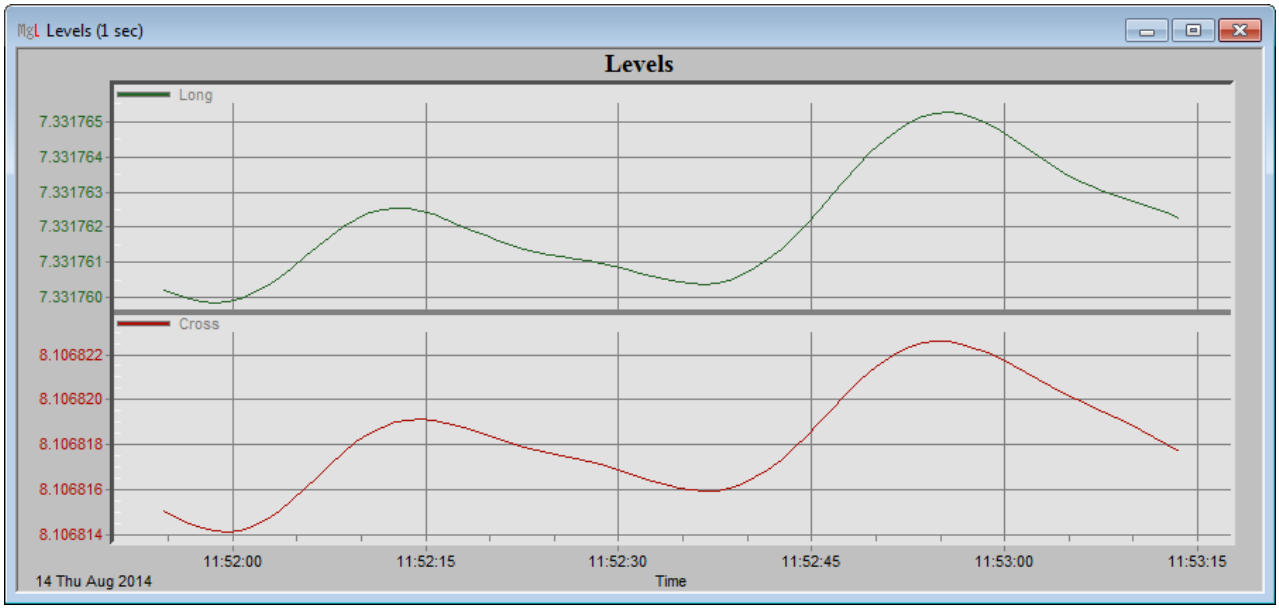

Figure 4-5 Levels View

The **Levels** view (Figure 4-5) displays the level data received from the meter, which includes long level and cross level. The levels data fit time range is set in the **Window (s)** parameter in the **Filtered Data** section on the **Setup** tab page in the **System Settings** dialog. Click **Settings** under the **System** menu.

Corrections View

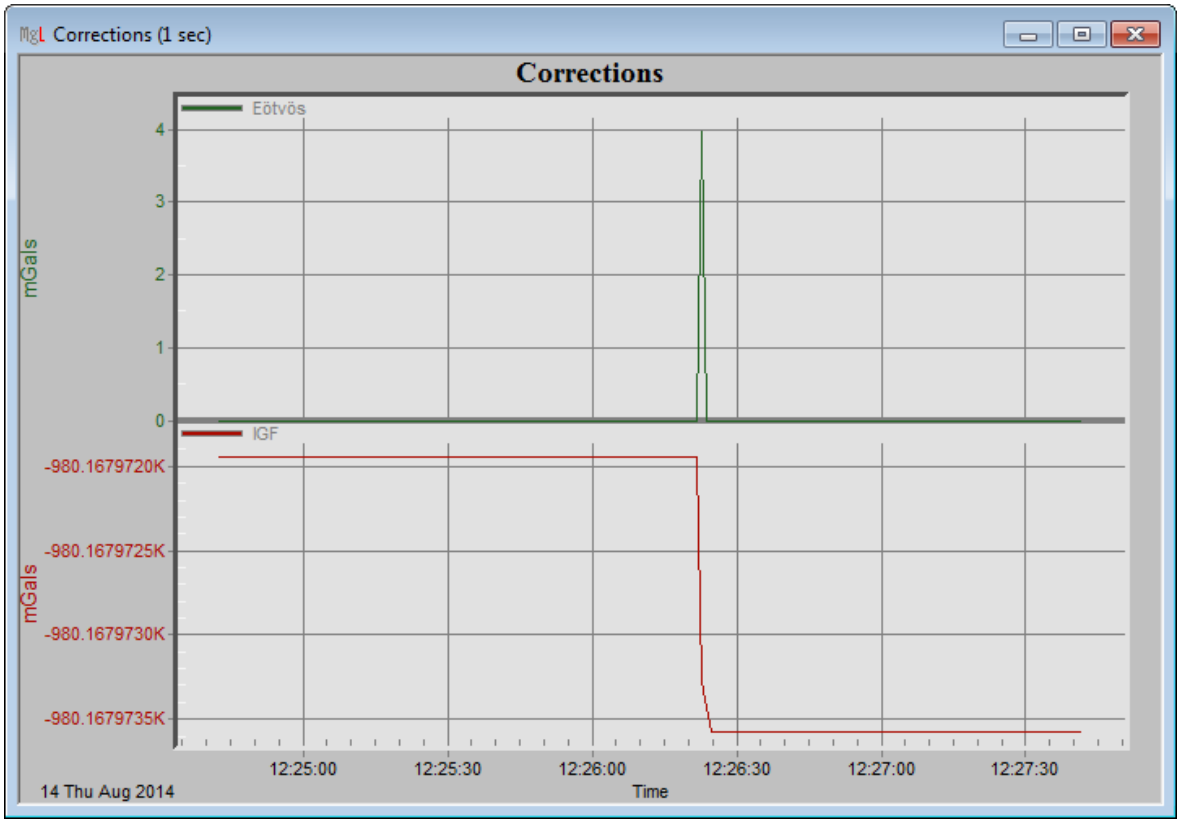

Figure 4-6 Corrections View

The **Corrections** view (Figure 4-6) displays the Eötvös and IGF data corrections received from the meter. Enable corrections from the **Corrections** tab page under the **System Settings** dialog. Click **Settings** under the **System** menu.

Controls View

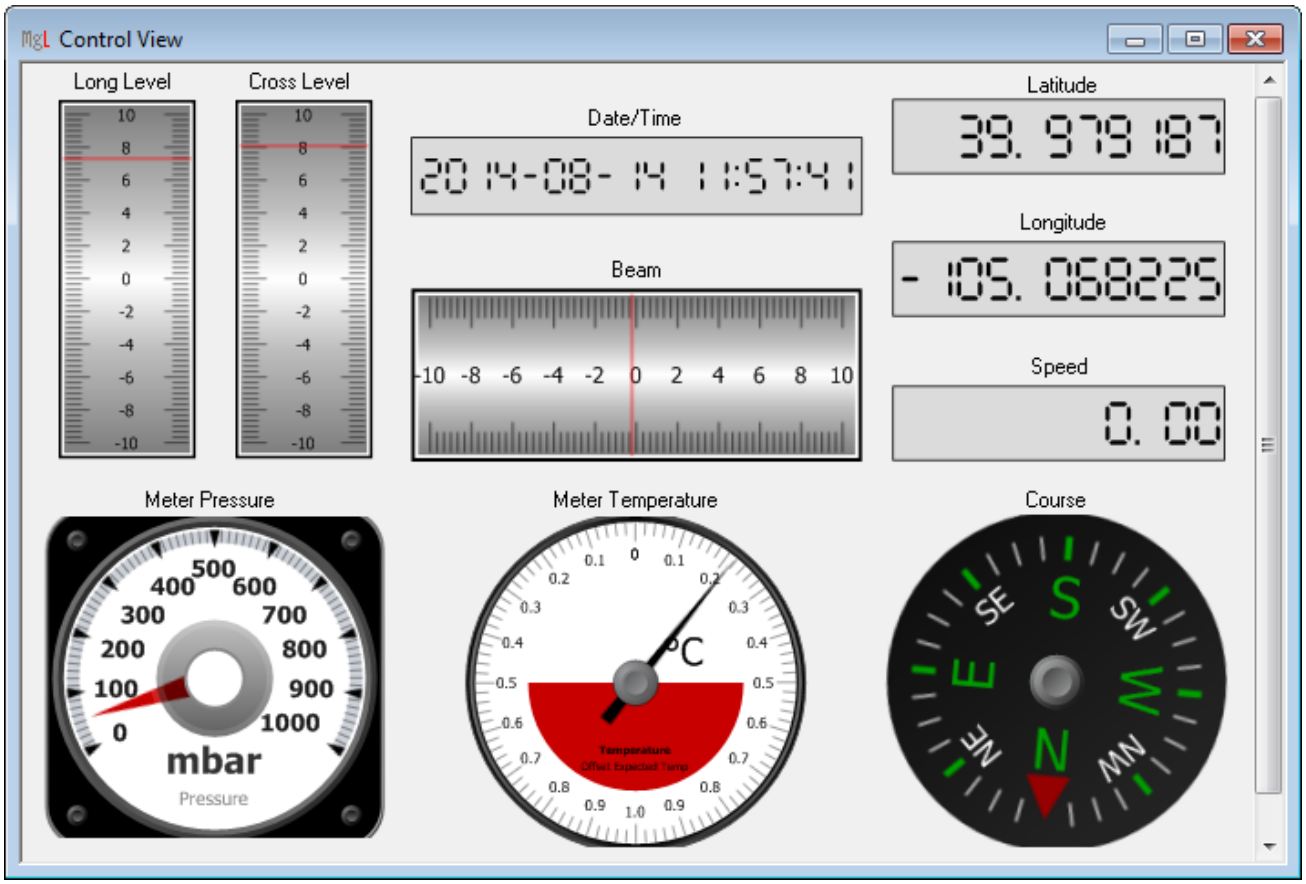

Figure 4-7 Controls View

The **Controls** view (Figure 4-7) shows real time meter status in a more visual type display. Certain fields may not update, depending on your GPS status.

Navigation Plot View

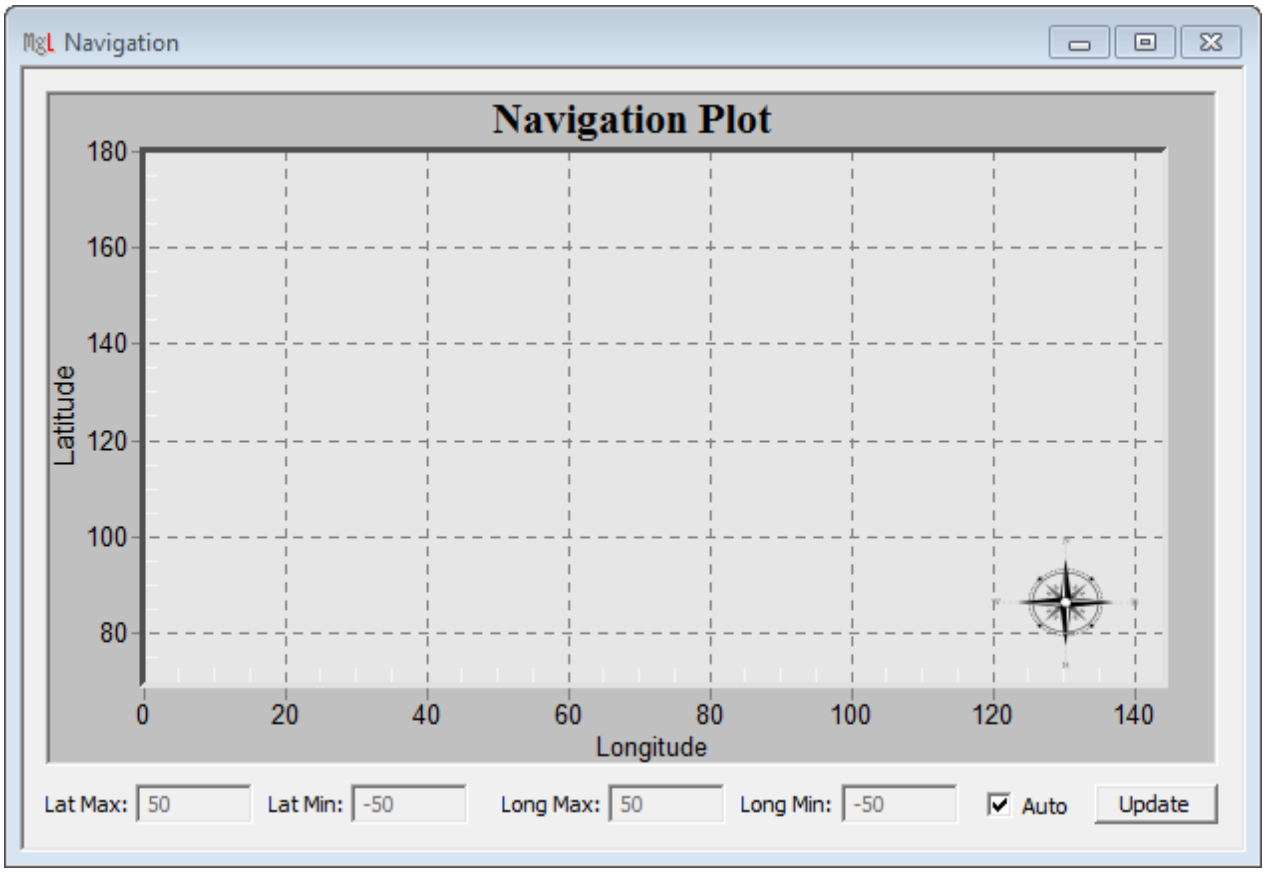

Figure 4-8 Navigation Plot View

The **Navigation Plot** (Figure 4-8) plots the current run latitude and longitude on a graph so you can see what your course has been. The latitude and longitude max/min can be set using the lower text boxes or set to be automatic. In order to update the min/max, click **Update**. The navigation plot will not update if there is no GPS input or the meter is stationary.

Filtered Channels View

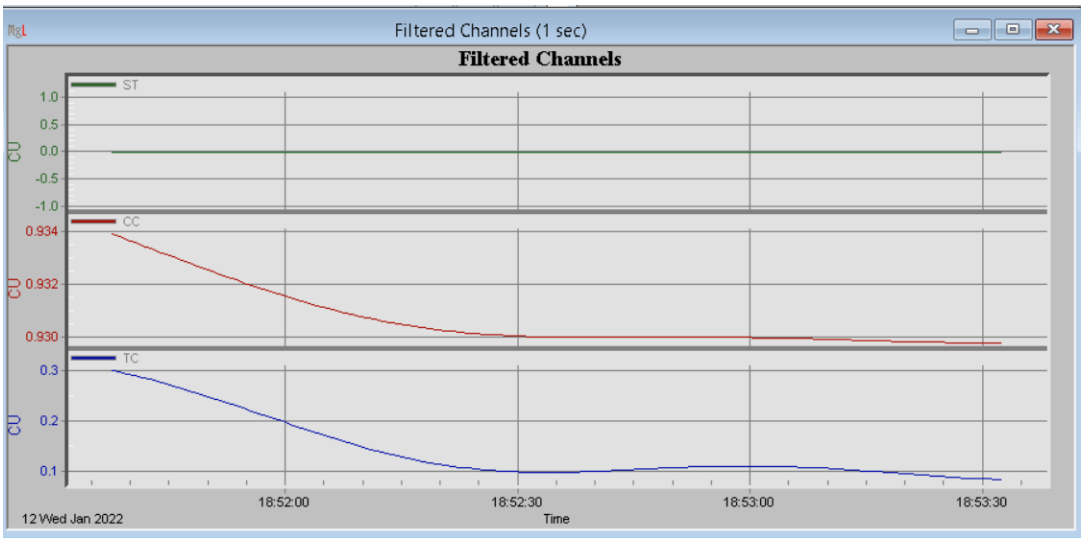

Figure 4-9 Filtered Channels View

The **Filtered Channels** view Figure 4-9) displays the filtered spring tension (ST), cross coupling (CC), and total correction (TC).

Gyros View

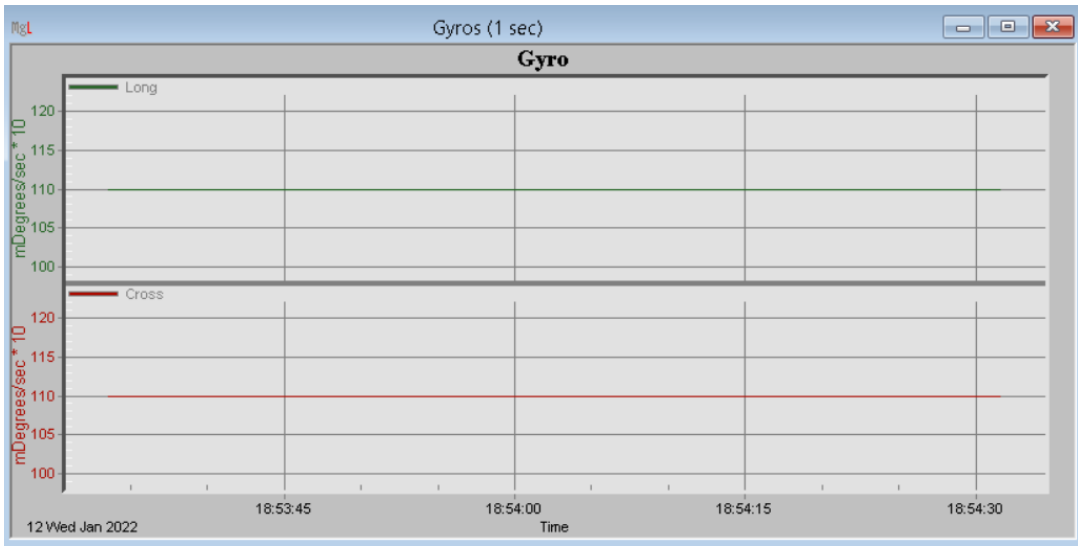

Figure 4-10 Gyros View

The **Gyros** view (Figure 4-10) displays the gyro data received from the meter which includes the long gyro and cross gyro.

Raw Beam View

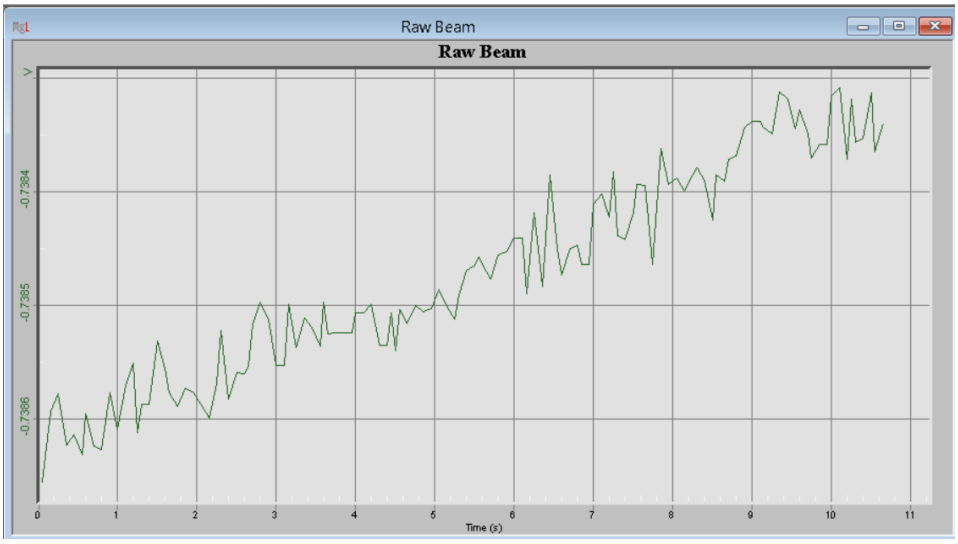

Figure 4-11 Raw Beam View

The **Raw Beam** view (Figure 4-11) displays the raw 20 Hz beam position as it was received from the meter. The graph automatically scrolls after a fixed amount of time passes.

Raw Spring Tension View

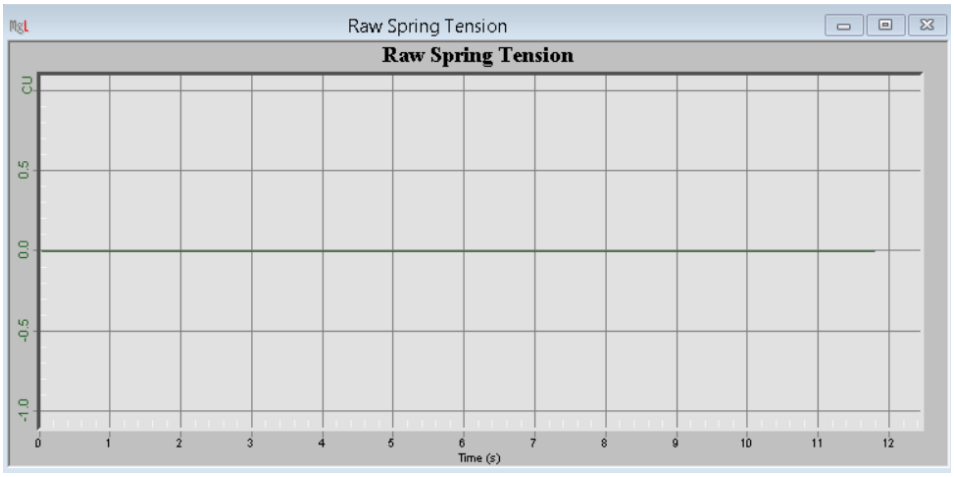

Figure 4-12 Raw Spring Tension View

The **Raw Spring Tension** view (Figure 4-12) displays the raw 20 Hz spring tension as it was received from the meter. The graph automatically scrolls after a fixed amount of time passes.

Lag Corrections View

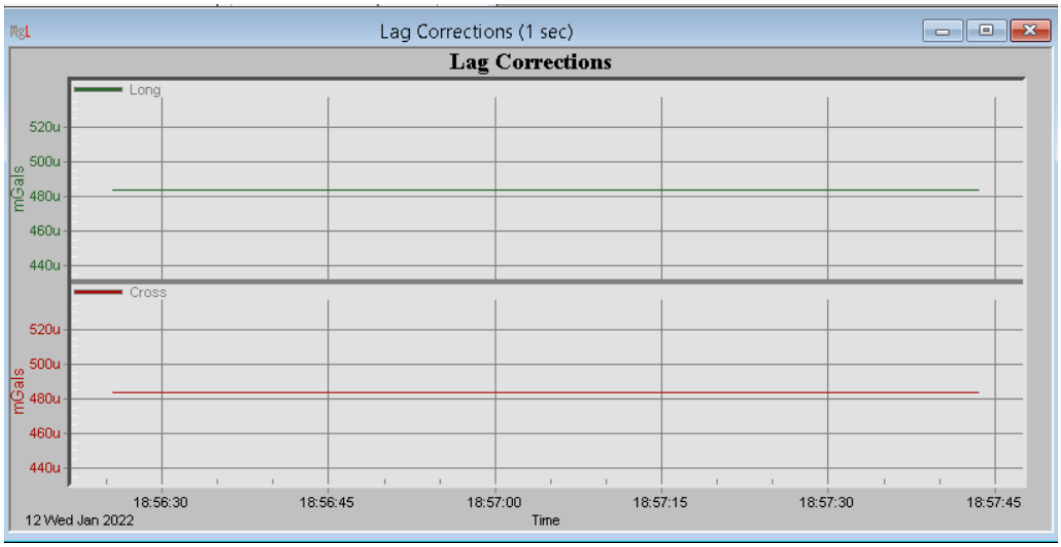

Figure 4-13 Lag Corrections View

The **Lag Corrections** view (Figure 4-13) displays the long and cross accelerometer lag corrections calculated from the received gyro value.

Modifying The Views

Reset All Graphs

Selecting Reset All Graphs under the View menu, clear and resets all graphs. Resetting the view(s) only clears the view, it does not clear the data from the data files or filters.

Every view can also be cleared and reset by unselecting and reselecting the view from the **View** menu.

Customize Graph Style

The graphic appearance can be customized by double clicking on the graph to bring up the customization dialog. Figure 4-14 shows an example **Filtered Gravity Customization** dialog. To display the default configuration, simply close the graph and reopen it from the **View** menu

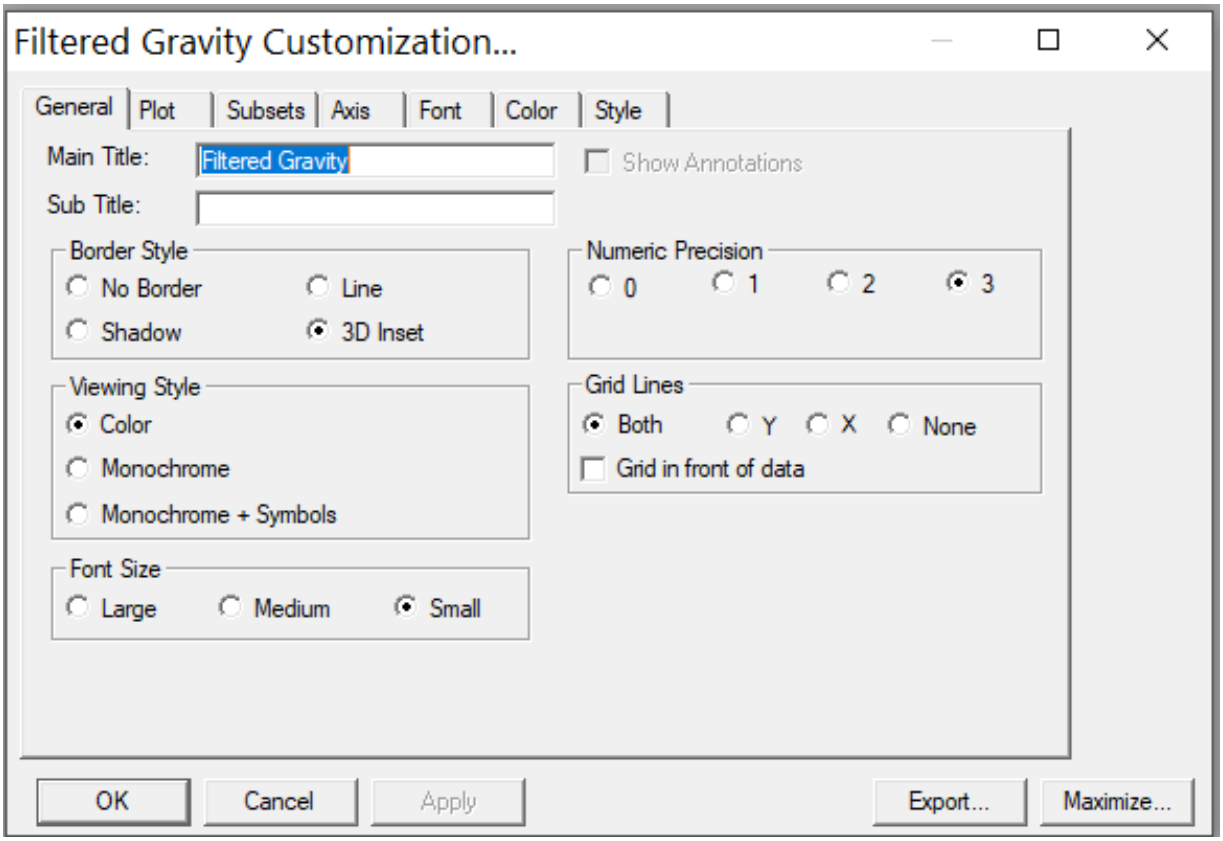

Figure 4-14 Filtered Gravity Customization Dialog

IMPORTANT Viewing many graphic displays can slow down data processing. Typically not an issue for the supplied laptops, however, user supplied laptops must meet or exceed specifications of the supplied laptops.

If your system does NOT have a good graphics card (>32mb on-board memory) or the system is running slower than anticipated, minimize the number of open views.

For a full screen view of the graph, click the **Maximize** button in the bottom right corner of the **Gravity Customization** dialog. To close the maximize view, press the **Esc** key.

To export the view, click the **Export** button in the bottom right corner of the **Gravity Customization** dialog. Select the file type, destination and size then click **Export**.

Modify Y-Axis

To customize the y-axis for each graphic, from the **System** menu select **Graphics**. In the **Graphics Setup** dialog set the Max and Min range for each graphic. Refer to Section 07 Additional Menu Options, "Graphics" for detailed information.

5. ACQUIRING DATA

Before acquiring new data, open the program and make sure the system settings are set correctly for the meter as well as for the user preferences. From the **System** menu select the **Settings** option. Once the acquisition has started, most of these settings cannot be changed.

IMPORTANT	The time on the PC Clock must be set to Coordinated Universal Time (GMT), not local time, with daylight savings disabled.

To acquire new data:

- From the **File** menu select **New**.
- Then select the directory for the data to be stored when prompted.
- If **Output File Backup** is enabled in the **Setup** tab of the **System Settings** dialog, you will be asked to select the secondary backup location and filename.

Directory Selection

It is recommended that you create a different directory for each new acquisition especially if parameters change. The newly created directory not only stores the data, but it also stores a new, local PiperPro.ini file.

This local PiperPro.ini file must accompany the data if it is moved (or archived) because it contains the settings for that particular acquisition. The default directory used at Microg LaCoste for storing all the data directories is C:\gData\PiperPro. This directory can be created by the user after installation if it does not already exist.

Acquiring Data

Once a directory and file have been selected, Sea3 PiperPro begins receiving data and updating the view windows. At this point, the system is storing data.

IMPORTANT	Sea3 data is stored in automatically named files consisting of the date, meter, and meter ID (YYYY_MM_DD_MGS_XXX.DAT, XXX – three digit meter ID). There is one file per day.

The new Sea3 meter outputs raw data at 20Hz. The Sea3 PiperPro software can record both 1Hz and 20Hz .DAT or .TSoft files.

The DAT files are space delimited plain ASCII files that can be read using a spreadsheet application. TSoft files are tab-delimited files that have a detailed and specific header and can be imported into the TSoft reprocessing and analysis software.

Reset Graphs

Once the data is deemed acceptable, the meter should be set to **Online**. Once data is being acquired, reset all the graphs views by selecting **Reset Graphs** under the **View** menu.

Data Files

The 20 Hz raw data (*.txt files) is stored every time new data is acquired from the meter (an option for Sea3 but a good practice to store the 20 Hz *.txt file). The text output files (DAT or TSoft) are also updated once every second.

Sea3 Timing

Meter Data

The Sea3 meter outputs data at a rate of 20Hz. A data packet is a serial ASCII string sent from the Sea3 meter that contains meter data such as Gravity, Temperatures, Levels, etc. You can view the raw ASCII string in the **Meter ASCII Output** located in the **Sea3 Data** window.

GPS Synchronization

The Sea3 timing box is equipped with a GPS unit. This GPS unit synchronizes with the onboard rubidium clock if connected to an external antenna and a valid GPS signal is attained. Once a GPS lock is attained, Sea3 PiperPro can then synchronize the onboard rubidium clock to the GPS clock. To do this select Synchronize Clock in System.

GPS Data

There are two ways to send GPS data to PiperPro.

The first option is to attach a GPS antenna to the GPS unit. When the signal is locked, a NMEA RMC serial string is sent on the same serial line as the meter data. This data is parsed inside Sea3 PiperPro and GPS data such as date, time, latitude, longitude, course and speed is extracted. This data is used to calculate corrections used in real time. This data is also stored into the data file (DAT or TSoft). Set this option by selecting **From Meter** in the **Setup** tab of **System Settings** dialog.

The second option for acquiring GPS data is to directly attach to the system computer a serial line that transmits continuous 1Hz serial NMEA GPS strings. There is no direct handshaking on this GPS serial line, so the data must be continuously sent. The GPS data is parsed and GPS data such as date, time, latitude, longitude, course and speed are extracted. This data is used to calculate corrections used in real time. This data is also stored in the data file. Set this option by selecting **From Vessel** in the **Setup** tab of **System Settings** dialog. The settings for this serial port can be configured by clicking the **Port Setup** button located next to the **From Vessel** option. The user can also select either **NMEA: V2.3**+ or **Pre-V2.3**.

Currently there are three types of accepted NMEA GPS string formats: RMC, GLL, and VTG.

RMC

NMEA has its own version of essential GPS pvt (position, velocity, time) data. It is called RMC, The Recommended Minimum, which will look similar to:

$GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A

Where	
RMC	Recommended Minimum sentence C
123519	Fix taken at 12:35:19 UTC
A	Status A=active or V=Void.
4807.038,N	Latitude 48 deg 07.038' N
01131.000,E	Longitude 11 deg 31.000' E
022.4	Speed over the ground in knots
084.4	Track angle in degrees True
230394	Date - 23rd of March 1994
003.1,W	Magnetic Variation
*6A	Checksum data

NOTE As of the 2.3 release of NMEA, there is a new field in the RMC sentence at the end just prior to the checksum.

GLL

Geographic Latitude and Longitude is a holdover from Loran data. The string should look similar to this:

$GPGLL,4916.45,N,12311.12,W,225444,A,*1D

Where	
GLL	Geographic position, Latitude and Longitude
4916.46,N	Latitude 49 deg. 16.45 min. North
12311.12,W	Longitude 123 deg. 11.12 min. West
225444	Fix taken at 22:54:44 UTC
A	Data Active or V (void)
*1D	Checksum data

NOTE As of the 2.3 release of NMEA, there is a new field in the GLL sentence at the end just prior to the checksum.

VTG

Velocity made good. The string should look similar to this:

$GPVTG,054.7,T,034.4,M,005.5,N,010.2,K*48

Where	
VTG	Track made good and ground speed
054.7,T	True track made good (degrees)
034.4,M	Magnetic track made good
005.5,N	Ground speed, knots
010.2,K	Ground speed, Kilometers per hour
*48	Checksum data

NOTE As of the 2.3 release of NMEA, there is a new field in the VTG sentence at the end just prior to the checksum.

NOTE In order to get the required data needed for Sea 3 corrections, RMC or both GLL and VTG are required.

Graphics

The user can:

- Change the graphics settings.
- Update the graphing windows by closing and reopening the graphic window.
- Manipulate the graphs and locations.

While data is being received, the user can change the graphics by selecting the **Graphics** options available in the **System** menu. Figure 5-1 shows an example of the **System** menu. Refer to Section 07 Additional Menu Options "Graphics" for additional information and example dialog.

To modify the graphic appearance, double click on any individual graph in the **Sea3** main window. Refer to Section 04 PiperPro

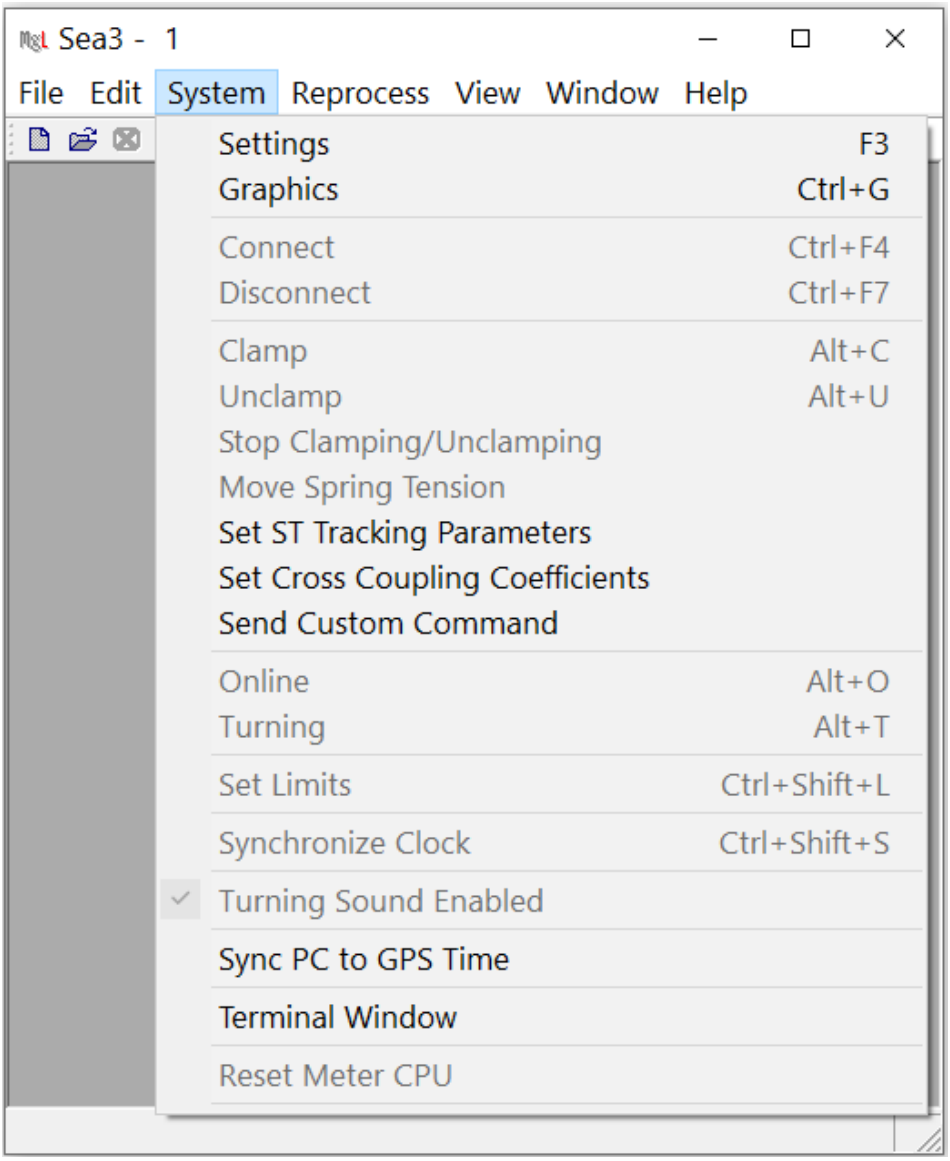

Figure 5-1 System menu selection list

Main Window And View "Customize Graph Style" for additional information.

Hardware Communication

Communicate With Meter

Refer to Figure 5-1 to see list of options available under the **System** menu. The user can:

- Connect/Disconnect
- Clamp/Unclamp the meter
- Stop Clamping/Unclamping
- Synchronize Clock/Use Internal Clock
- Set mode Turning/Online
- Sync Pc to GPS Time
- Set Limits
- Moving Spring tension
- Set ST tracking Parameters
- Set Cross Coupling Coefficients
- Send Custom Command
- Terminal Window
- Reset Meter CPU

The meter sends out a status line to inform Sea 3 of its current status. Sea3 PiperPro automatically enables and disables options based on the status of the meter.

View Meter Status

Status of the meter can be viewed from the status bar or from the **Sea3 Data** window.

Status Bar

The status bar, shown in Figure 5-2, can display a variety of status indicators and is located in the bottom frame of the **Sea3** main application window.

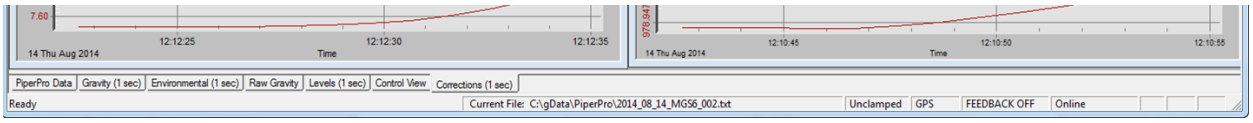

Figure 5-2 Status Bar

The status bar can display the following information:

- The current open file.
- Whether the meter is clamped or unclamped.

- Whether data is synced to GPS.
- Whether the data is set to Online or Turning.
- Whether Feedback is On or Off.

Sea3 PiperPro Data Window

The meter status is also indicated in the **Sea3 Data** window. Refer to Figure 5-3.

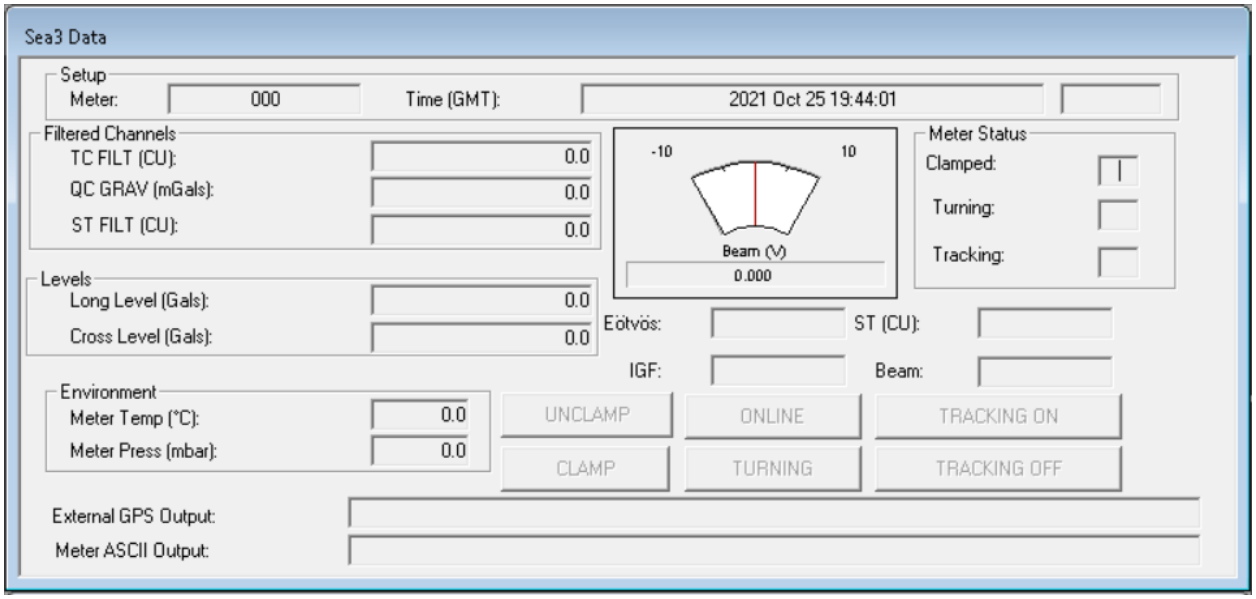

Figure 5-3 Meter Status Displayed in PiperPro Data Window

6. POST-PROCESSING

This section describes how to reprocess data that has already been acquired. Acquiring data in real time is discussed below.

Starting Sea3 and the Global .ini File

Start Sea3 PiperPro by double clicking on the Sea3 PiperPro icon. The **Sea3** main window shown in Figure 6-1 will appear.

NOTE No data is loaded at this point. Any changes made in **Settings** affect the global .ini file. If you change and save any settings at this point, the software will warn you that you are making a global change that affects all future data acquisition.

Refer to Section 03 System Settings "Local .ini File" for more information.

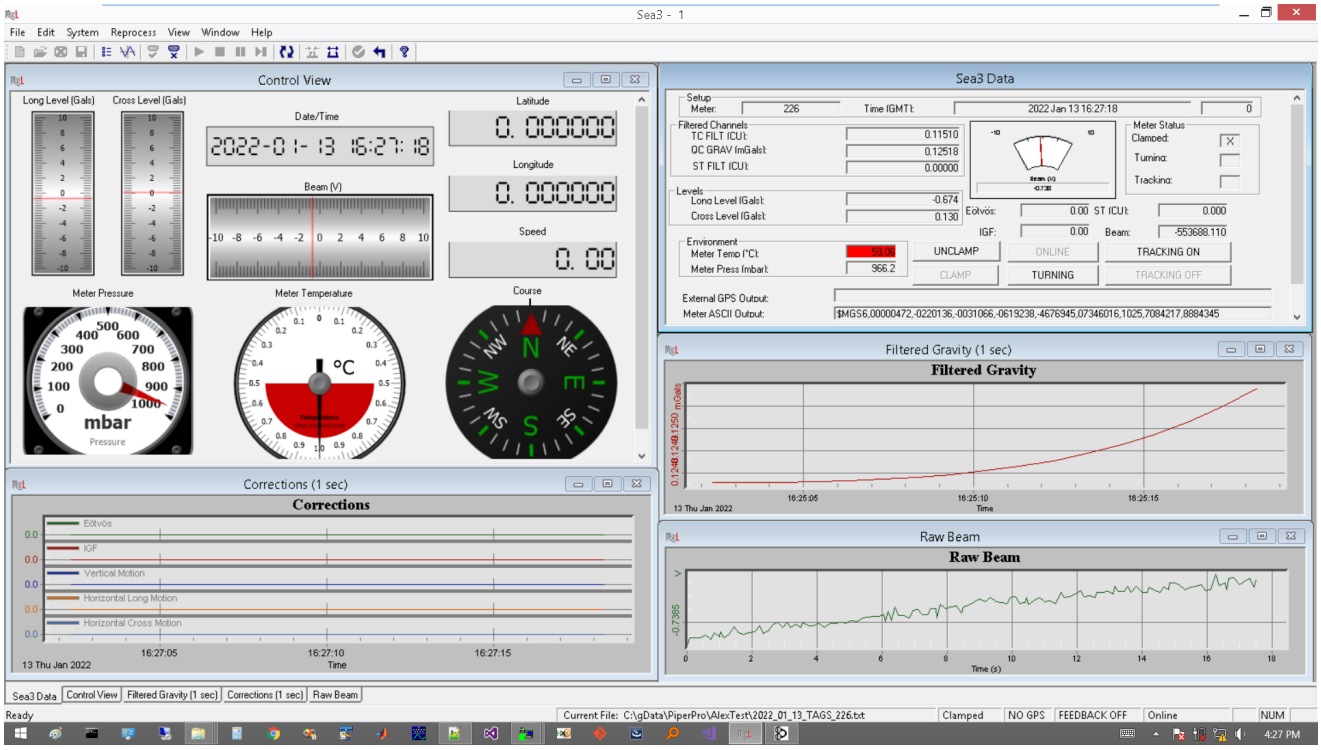

Figure 6-1 Open Project

Loading Existing Data

To load existing data:

- From the **File** menu select **Load**.
- The **Select Data File** dialog opens. Refer to Figure 6-2.

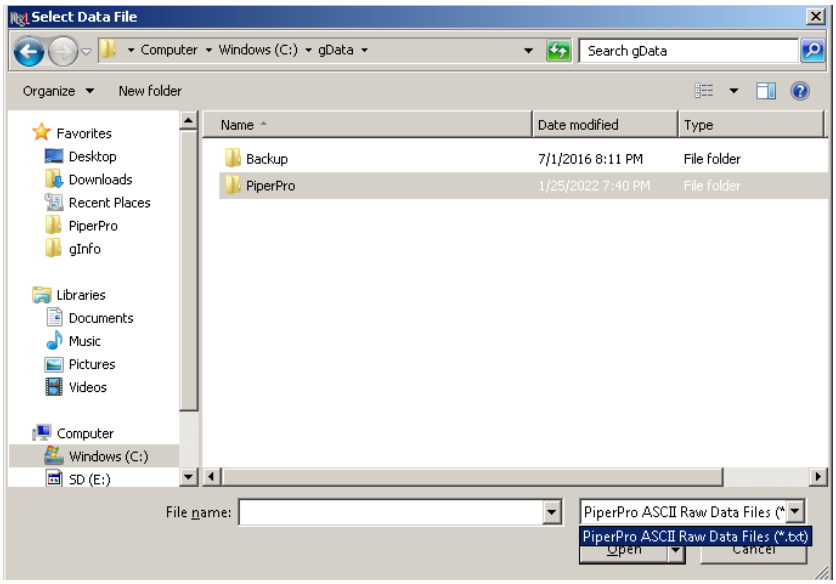

Figure 6-2 Select Data File: File

Extension Selection

- Navigate to the desired directory.
  - Select the file for the desired day.
  - The file extensions vary depending upon the system and data. Figure 6-2 shows an example selection drop down list.

- The **Load Type** dialog shown in Figure 6-3 appears.
  - Select the load type (**Quick** or **Visual**).Then click **OK**.
  - Refer to the Load Types section below for additional information.

- The **Selection Configuration File** browser dialog opens
  - Navigate to the desired directory.
  - Select the *.ini file for the current configuration file

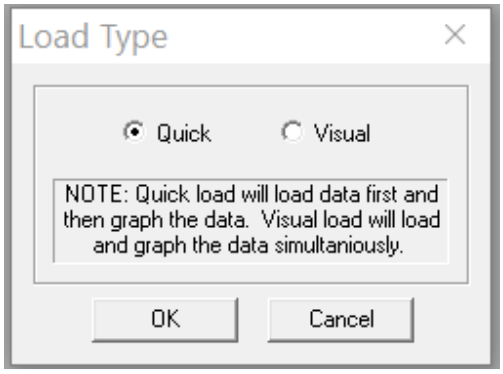

Figure 6-3 Load Type Dialog

Load Types

There are two different ways of loading and processing files.

Quick

Quick load loads and processes the entire data set that you select and then graphs the data. This is the quickest way of loading and processing the data.

Visual

Visual load loads and graphs the data simultaneously. This is a much slower approach, but it allows the user to see all the data in detail as it is processed.

In the latest version of Sea3 PiperPro (1.20.11.23.10.34), if the data you are trying to reprocess data recorded with an older version (1.200724 or earlier), a warning message will appear (inset the Figure below) and the process will abort (Figure 6-4)

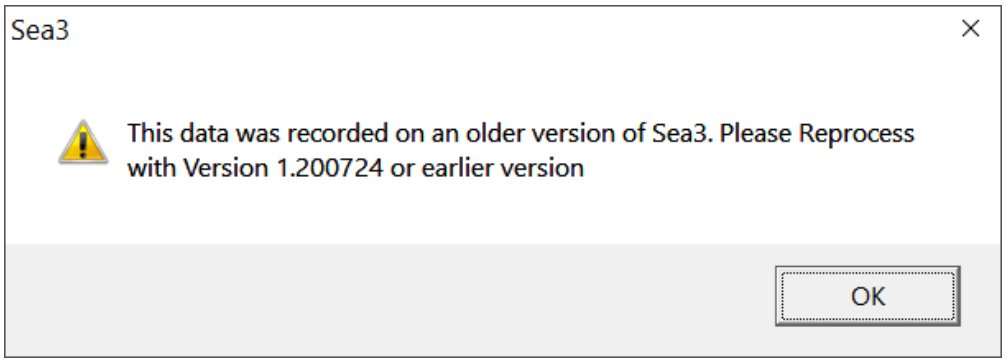

Figure 6-4 Load data version warning

Post Processing Data

To start loading and re-processing data, select **Start** from the **Reprocess** menu.

If **Quick** load was selected, then all the data is initially loaded before the graphs and windows are updated.

If **Visual** load was selected, then the processing can be stopped or paused at any time, and the user-set parameters can be changed at any time.

The user can change any parameters by selecting **Settings** from the **System** menu (or **F3**). Refer to Section 03 System Settings "Modify System Setting Parameters" for more information. To begin processing again, select **Start** from the **Reprocess** menu (or **F5**). The load type cannot be changed once the file has begun processing. To change load type, reload the file by selecting **Load** from the **File** menu.

During a Visual Load, the user can pause by selecting **Pause** from the **Reprocess** menu. The user can then select **Start** (to restart the process) or **Step** (to step through the process) from the **Reprocess** menu.

Clearing Graph Data

Every graph can be closed and reopened from the **View** menu. Closing and reopening a graph view clears the data from the graph window. You can also clear all data from all graph windows by selecting **Reset All Graphs** under the View menu.

Customizing Graph Data

The graphs can also be customized by clicking anywhere on the graph to bring up the customization dialog. See Section 04 PiperPro Main Window And Views "Customize Graph Style" for detailed information.

Each graph's y-axis can also be customized from within the **Graphics Setup** dialog. To access the **Graphics Setup** dialog, select **Graphics** from the **System** menu. These values are also saved to the *.ini text project file. See Section 07 Additional Menu Options "Graphics" for additional details and an example dialog.

To reset the graph after customizations, the user can simply close the graph and reopen it.

IMPORTANT	Viewing many graphic displays can significantly slow down data processing. If your system does NOT have a good graphics card (>32mb on-board memory) or the system is running slower than anticipated, minimize the number of open views.

7. ADDITIONAL MENU OPTIONS

File

New

The **New** option creates a new project file from the current System | Settings. Once an output directory has been selected, all the project files are created and data acquisition begins.

Load

The **Load** option loads an existing file. The user can choose Quick load or Visual load. The Quick load loads the entire selected data set and then graphs the data. This is the quickest way of loading the data. The Visual load loads and graphs the data simultaneously. This is a much slower approach, but loads everything sequentially.

Close

The **Close** option closes an opened file. Upon closing, the main PiperPro.ini file is reloaded.

Save

The **Save** option saves the current file. PiperPro warns the user if they are saving over the main PiperPro.ini file that is located in the software installation directory.

Exit

The **Exit** option exits the program.

Edit

Time Offset

The **Time Offset** option allows application of a time shift in the event that the computer time was not set to the correct time. To calculate the offset, change the **True Start Time** to the correct time (the time that should have been). Check the time offset as listed in the grayed edit box. If the time offset is correct, check the **Apply Time Offset** option to make the time offset effective during processing. This option only pertains to reprocessing of data. Refer to Figure 7-1.

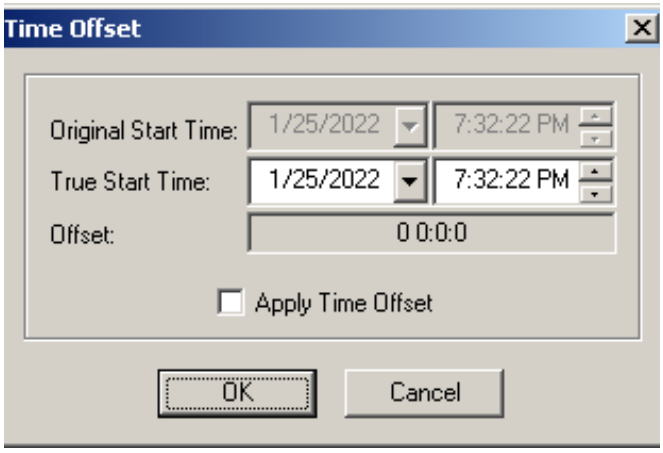

Figure 7-1 Time Offset Dialog

Processing Rate

The **Processing Rate** sets the processing rate. This option only pertains to reprocessing of data. Some computers are slower and thus the software allows for more reprocessing time to reduce the chances of a computer crash or system overload.

System

Settings

The **Settings** option allows changes to any of the system settings including **Setup**, **Calibration** and Corrections. These settings are unavailable during real-time acquisition, but can be altered before acquisition and reprocessing.

Graphics

The **Graphics** option opens the **Graphics Setup** dialog which allows customization of the y-axis scale for the **Gravity Filtered**, **Environment**, **Levels** and **Corrections, Spring Tension, Filtered Channels and Gyros** graphs. Each graph can be set up independently to either be auto-scaled or user-scaled.

Figure 7-2 shows an example of the **Graphics Setup** dialog. These values can be saved to the *.ini file so the user does not have to reload them each time they start a new acquisition or reprocess the data.

The graphic style is modified in the customization dialog for each graph. Access the customization dialog by double clicking on the graph. Refer to Section 04 Sea3 PiperPro Main Window And Views, “Customize Graph Style” for more information.

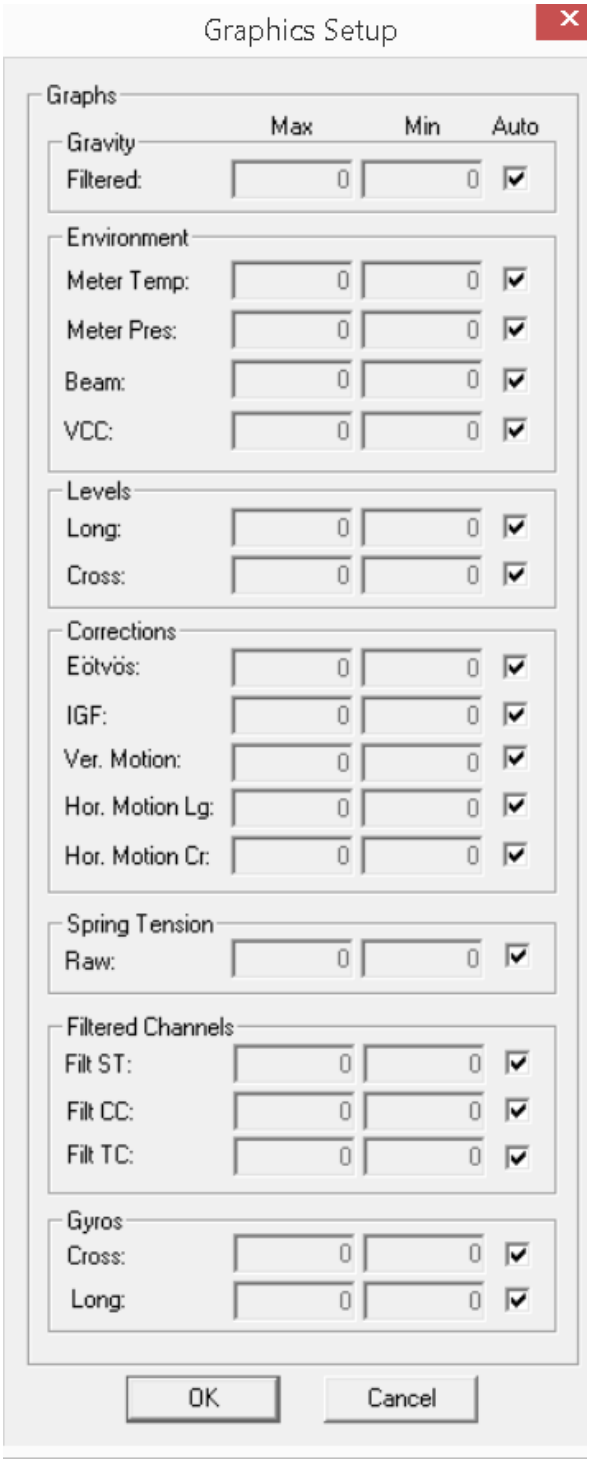

Figure 7-2 Graphics Setup Dialog

Connect

For this release, connect is an automated feature. It is a placeholder for a future usability feature.

Disconnect

Disconnects and closes the file. Currently this is a placeholder for a future usability feature.

Clamp

The **Clamp** option clamps the meter.

Unclamp

The **Unclamp** option unclamps the meter.

Stop Clamping/Unclamping

The **Stop Clamping/Unclamping** option tells the meter to stop clamping or unclamping.

Move Spring Tension

Use this option to move the spring tension.

Set ST Tracking Parameters

Use this option to set the ST tracking parameters.

Set Cross Coupling Coefficients

Use this option to set the cross coupling coefficients.

Send Custom Command

Use this option to send a custom command

Online

The **Online** option tells the meter that you are online. This is the ideal mode for acquiring data.

Turning

The **Turning** option tells the meter that you are turning. This mode is usually used while the aircraft/ship is turning and is not on a stable and direct path.

Set Limits

The **Set Limits** option tells the meter to set its internal limits.

Synchronize Clock

The **Synchronize Clock** option tells the meter to synchronize the onboard clock with the GPS clock. Once synchronization is achieved, the meter outputs a timestamp with the ASCII serial data string. This only pertains to TAGS-6 systems. .

Turning Sound Enabled

On the TAGS-6 system, an audible sound (beep) is heard while in turn mode.

Sync PC to GPS Time

If you have valid GPS and administrator rights to set the computer time, this will sync the computer clock to the GPS time.

Terminal Window

In the Terminal window, (Figure 73) type commands to be sent to the meter in the text box, then click **Send**. The "**Connect**" button disconnects the serial port connection,it will change to "Disconnect" when "Connect" is clicked. The **Exit** button closes the **Terminal** window and disconnects from the serial port if necessary.

Reset Meter CPU

Reboot the instrument's firmware.

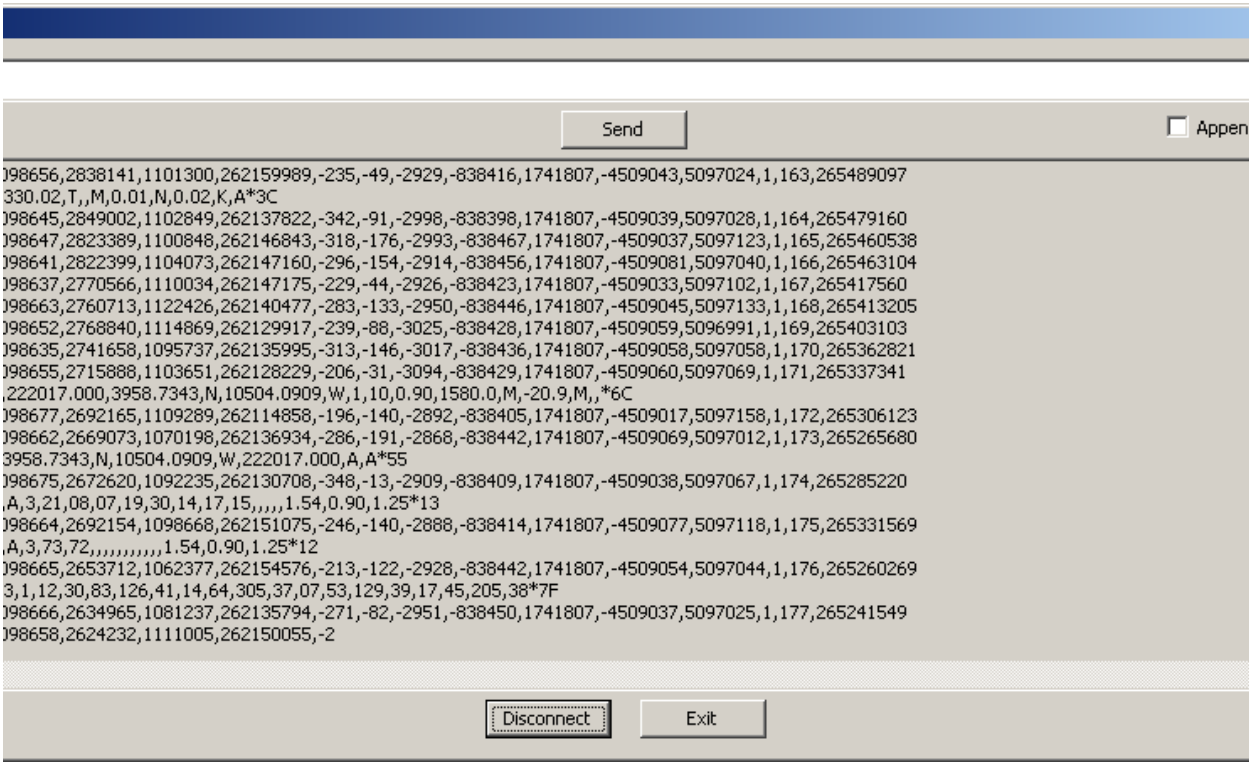

Figure 7-3 Terminal Window

Reprocess

Start

The **Start** option starts the processing in both post-processing and real-time acquisition.

Stop

The **Stop** option stops all processing in post-processing or real-time acquisition mode.

Pause

The **Pause** option pauses processing and can only be used in post-processing mode.

Step

The **Step** option processes data step-by-step in post-processing mode only.

View

The **View** menu allows all available graphs to be opened, closed or reset. If the graph is currently visible, there is a check mark next to the graph in the **View** menu list. Detailed description about the graphs can be found in Section 04 "PiperPro Main Windows And Views".

Filtered Gravity

Toggles Filtered Gravity graph Open/Close.

Environment

Toggles Environment graph Open/Close.

Gyros

Toggles Gyros graph Open/Close

Levels

Toggles Level graph Open/Close.

Corrections

Toggles Corrections graph Open/Close.

Platform Corrections

Toggles Platform Corrections Open/Close

Raw Spring Tension

Toggles Raw Spring Tension View Open/Close.

Raw Beam

Toggles Raw Beam View Open/Close.

Filtered Channels

Toggle Filtered Channels (ST, CC, TC) View Open/Close.

Lag Corrections

Toggles Lag Corrections (Long & Cross) View Open/Close.

Controls

Toggles Control View Open/Close.

Navigation Plot

Toggles Navigation Plot Open/Close.

Raw Serial output

Toggles Serial output View Open/Close.

Reset All Graphs

Resets all graphs.

Toolbar

Toggles Toolbar ON/OFF.

Status Bar

Toggles Status Bar ON/OFF.

Full Screen

Toggles Full Screen mode ON/OFF.

NOTE	When in full screen mode and the **Status Bar**, **Toolbar**, and **Menu** are not visible they can be enabled by pressing the **F12** key.

Window

The Windows menu lets users change the display style and also lists the currently open views.

Cascade

Displays the selected graphs in cascade mode.

Tile

Displays the selected graphs in tile mode.

Help

Sea3 Help

This will Open the PDF version of this manual.

About Sea3

Opens the **About Sea3** dialog showing the current Sea3 version information.

Update Firmware

WARNING	Only use this option under the direction of a Microg LaCoste engineer.

A firmware upgrade is sent when required. Follow the installation procedure under the direction of a Microg LaCoste engineer.

Clicking on **Update Firmware** brings up the **PIC32 Bootloader Application v1.2** dialog. Refer to Figure 7-4.

1. Click **Connect**.
2. Then click **Load Hex File**.
   - Select the upgrade firmware file in the displayed browser window.
   - Then click **Open**.
3. Click **Erase Program Verify**.
4. Click **Run Application**.

- The Update Firmware program will automatically close upon completion.

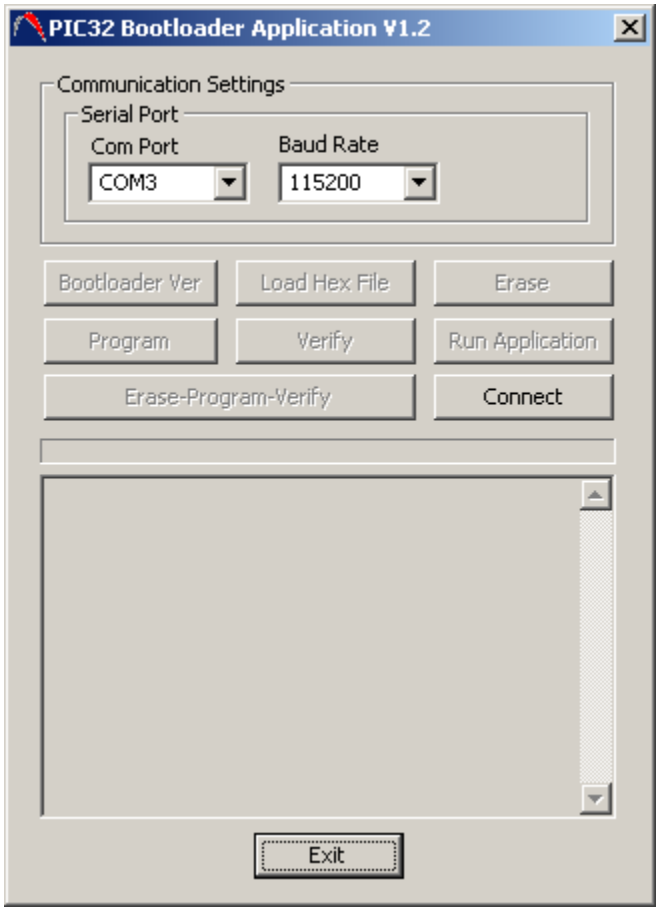

Figure 7-4 PIC32 Bootloader Application V1.2 Dialog

Configure Novatel

Not applicable to Sea 3.

Clear Error Log File

The **Clear Error Log File** option clears the error log.

Clear Event Log File

The **Clear Event Log File** option clears the event log.

8. GENERAL INFORMATION

License Information

Licensed users of Sea3 PiperPro are entitled to three install platforms with the Main License. Additional installations, including support, are purchased one seat at a time directly from Micro-g LaCoste. If your institution or company requires PiperPro Processing software to run on more than three platforms, please contact Micro-g LaCoste directly or visit our website, www.microglacoste.com, for more information.

Support

Contact

Questions concerning the operation of the PiperPro Processing software and any problems using PiperPro please contact Customer Service at support@microglacoste.com.

Expect a response via email or phone call within forty-eight hours of your inquiry.

Support Request

Provide complete detailed information to help us respond with a more accurate and timely response. Include software release version (select **About Sea3...** under the **Help** menu), a scenario description and list of steps to recreate the problem.

Maintenance

Periodically Micro-g LaCoste posts an upgrade "patch" for the Sea3 Processing software on the website. These patches are posted without notification so check back every few weeks to get the latest patch if applicable.

APPENDIX A DATA RECORD FIELDS

This appendix provides a description of the 1-second .DAT file format of the current MGL Sea-III marine gravity systems and the information needed to re-compute gravity from the raw data channels. The current data format contains legacy channels which will be removed in future release and new channels may be added. Any changes in future releases will be documented accordingly.

Data Formats

The 1-second .DAT file contains a header that provides general information such as meter ID, data acquisition software version, date, time and system setting parameters. The header lines start with the symbol /. The header information ends with a line containing only the symbol, /.

The data channel names start after the line:
/ Column Headers:

The software version 1.2010301517 or newer is different from previous versions, such as 1.1905311519, in how gravity is constructed. However, they contain identical data channels of a total of 56.

The total number of header lines vary in DAT files from different versions of Sea-III data acquisition software. Compared with previous versions, the version after 1.2010301517 contains two extra lines in the header:
/ Cross Gyro Lag Scale Factor:
/ Long Gyro Lag Scale Factor:

Channel Descriptions

There are 56 channels in the 1 Hz DAT file. Some of the SEA-III output data channels are included for backward compatibility with AirSea II and/or MGS6 data formats. These are indicated with asterisks (*), and will be removed in future releases. The channel names (listed after the line / Column Header:) are self-explanatory. Only a brief description of the record format, unit, and derivation (if needed) is given.

1. **Year**: YYYY
2. **Month**: mm
3. **Day**: dd
4. **Hour:** HH
5. **Minute**: MM
6. **Second:** SS

7. **MilliSec:** sss (Channels 1-7 give the timestamp of the data record)

8. **RawGravity**(mGals): Raw gravity, no corrections, no filtering. Formula for version newer than 1.2010301517:

   ```
   RawGravity = STCoefficient*(ST + BVCorr + CCCorr).
   ```

   For previous releases, such a version 1.1905311519, the formula is:

   ```
   RawGravity = STCoefficient*ST + BVCorr + CCCorr.
   ```

   Formulas for `BVCorr` and `CCCorr` are described later.

9. **CorrGravity**(mGals): is RawGravity (channel 8) with corrections applied, no filtering. Formula:

   ```
   CorrGravity = RawGravity + LongGyroCorr + CrossGyroCorr +
                 EotvosCorr* + IGFCorr*.
   ```

   * The EotvosCorr and IGFCorr are applied if enabled by the user.

10. **FilterWindow**(s): Sea3 PiperPro low-pass QC filter, in seconds.

11. **FiltCorrGravity**(mGals): Filtered CorrGravity (channel 9), with filter described in channel 10.

12. **LongLevel** (Gals): Platform long axis level (accelerometer)
13. **CrossLevel** (Gals): Platform cross axis level (accelerometer)

14. **LongLevelSquared** (Gals): The square of platform long axis level (12), in Gal^2 Gal^2. Note that the squaring is done in 20Hz, then anti-alias filtered and down sampled to 1Hz, so it won't exactly equal to the square of channel 12.

15. **CrossLevelSquared** (Gals): The square of platform long axis level (13), in Gal^2 Gal^2. Note that the squaring is done in 20Hz, then anti-alias filtered and down sampled to 1Hz, so it won't exactly equal to the square of channel 13.

16. **MeterTemp** (°C): meter internal temperature

17. **MeterPres** (mbar): meter internal pressure

18. **Beam** (V): Meter Beam position in Volts.
19. **Beam750K*:** Meter beam position, in volts × 750000. This field is for backwards compatibility with AirSeaII systems and will be removed in future release.

20. **VCC**: VCC cross-coupling channel, unitless.

21. **EötvösCorr** (mGals): Eötvös correction (from GPS).

22. **IGFCorr** (mGals): International Gravity (Normal Gravity) Formula (latitude from GPS) correction.

23. **VerMotionCorr** (mGals)***:** Vertical motion correction. Will be removed in future release.

24. **HorMotionLongCorr** (mGals)***:** Horizontal motion (long axis) correction. Will be removed in future release.
25. **HorMotionCrossCorr** (mGal)***:** Horizontal motion (cross axis) correction. Will be removed in future release.

26. **VerMotionStdDev** (Gals)***:** Vertical motion standard deviation. Will be removed in future release.

27. **HorMotionLongStdDev** (Gals)***:** Horizontal motion (long axis) standard deviation, will be removed in future release.
28. **HorMotionCrossStdDev** (Gals)***:** Horizontal motion (cross axis) standard deviation. Will be removed in future release.

29. **Latitude** (dd, +N): Latitude in decimal degrees from GPS
30. **Longitude** (dd, +E): Longitude in decimal degrees from GPS

31. **Course** (deg): vessel course direction in decimal degrees from geographical, computed from GPS. Compass convention: North 0 degree and East 90 degree.

32. **Speed** (kn): vessel total speed in knots, computed from GPS.

33. **Meter Status** (Byte): Meter status, see Table A-1 to decode.

34. **Timer** (ms): Internal diagnostic only

35. **VE**: VE cross-coupling channel, unitless
36. **AL**: AL cross-coupling channel, unitless
37. **AX**: AX cross-coupling channel, unitless
38. **AX2**: AX2 cross-coupling channel, unitless

39. **ST**: Spring Tension, in ST Counter Unit.

40. **CrossGyro**: angular velocity in 1×10^{-4} 1×10^{-4} deg/s
41. **LongGyro**: angular velocity in 1×10^{-4} 1×10^{-4} deg/s
42. **ZGyro** vertical gyro angular rate, in 1×10^{-4} 1×10^{-4} deg/s (note: for future use, not used at present).

43. **CrossGyroCorr** (mGals): Cross gyro correction
44. **LongGyroCorr** (mGals): Long gyro correction

45. **FiltCrossGyroCorr** (mGals): filtered channel 43, filter defined in channel 10 applied.
46. **FiltLongGyroCorr** (mGals): filtered channel 44, filter defined in channel 10 applied.

47. **FiltST**: filtered ST (channel 39) filter defined in channel 10 applied.

48. **FiltTC:** Filtered total correction. Filter defined in channel 10 applied. Unit in mGals. Total correction is a legacy terminology and will be removed in future release. Refer to Appendix A for more details.

49. **FiltCorrQCGravity*:** The same as FiltCorrGravity, in mGals. Will be removed in future release.

50. **FiltVCC:** Filtered VCC (channel 20) cross-coupling, unitless. Filter described in field 10 applied.

51. **FiltEötvösCorr**(mGals): Filtered channel 21. Filter described in field 10 applied.

52. **FiltIGFCorr**(mGals): Filtered channel 22. Filter described in field 10 applied.

53. **FiltVerMotionCorr** (mGals)***:** Filtered vertical motion correction (channel 23). Filter described in field 10 applied. Will be removed in future release.

54. **FiltHorMotionLongCorr** (mGals)***:** Filtered Horizontal motion (long axis) correction (Channel 24), with the filter described in field 10 applied. Will be removed in future release.

55. **FiltHorMotionCrossCorr** (mGals)***:** Filtered Horizontal motion (cross axis) correction (channel 25) with the filter described in field 10 applied. Will be removed in future release.

56. **GPSTime**(HHMMSS): time stamp from the most recent GPS data received.

Table A-1 Meter status bits

BIT	FUNCTION	DEC
0	CLAMPED (firmware thinks it is clamped)	1
1	UNCLAMPED (firmware thinks it is unclamped)	2
2	PPS_SYNC (firmware thinks it got a proper GPS sync) (not applicable for Sea3)	4
3	TURNING_MODE (1 = turning mode on, 0 = turning mode off) (not applicable for Sea3)	8
4	FEEDBACK (feedback closed loop is enabled)	16
5	Not used	32
6	REPEATED DATA LINE (PiperPro sets or clears this bit)	64
7	GPS Valid (PiperPro sets or clears this bit)	128
8	INTERNAL_TIMING MODE (1 == ON, 0 == OFF)	256
9	ST_TRACKING_ENABLED	512
10	ST TRACKING ERROR (limit switch)	1024

Computing Gravity from Raw Data in the 1HZ DAT File

Raw Gravity

For versions newer than 1.2010301517, the raw gravity is computed as:

```
RawGravity = STCoefficient*(ST + BVCorr + CCCorr)          (1)
```

For previous versions:

```
RawGravity = STCoefficient*ST + BVCorr + CCCorr            (2)
```

Where:

`STCoefficient`: the spring tension coefficient that converts the spring tension counter unit into mGal. It is found in the [Spring] section of the .ini file.

`BVCorr`: Beam Velocity Correction which is calculated as:

```
BVCorr = BeamVelocity*(p0+p1*Beam+p2*Beam^2) + q1* Beam + q2* Beam^2
                                                           (3)
```

The coefficients `p0, p1, p2, q1 and q2` are in the [AirSeaCalibrations] of the ini file. The BeamVelocity in the version 1.2010301517 or newer is calculated using the central difference (3-point) of the beam position.

```
BeamVelocity = (Beam(k+1) - Beam(k-1))/(2*dt)              (4)
```

The previous versions use two-point differences of the Beam position.

```
BeamVelocity = (Beam(k) - Beam(k-1))/dt                    (5)
```

Where dt = 1 for 1Hz data.

`CCCorr`: cross-coupling correction which is computed as:

```
CCCorr = VCCCoefficient*VCC + VECoefficient*VE + ALCoefficient*AL +
         AXCoefficient*AX + AX2Coefficient*AX2             (6)
```

The coefficients are in the [AirSeaCalibrations] of the ini file.

In future releases, the cross-coupling channels will include the scaled LongLevelSquared and CrossLevelSquared, which will be terms L2 and X2.

Corrected Gravity

$$CorrGravity = RawGravity + LongGyroCorr + CrossGyroCorr + EotvosCorr + IGFCorr \quad (7)$$

The EotvosCorr and IGFCorr are applied if enabled by the user in the ini file.

Total Correction (TC)

The Total Correction (TC) is a legacy terminology carried from AirSeaII, where

$$TC = Beam\ Scale\ factor * beam\ velocity + CC \quad (8)$$

In the Sea-III system release before version 1.2010301517, the total correction is:

$$TC = BVCorr + CCCorr \quad (9)$$

In spring tension counter units.

In future releases, the TC channel will be removed and instead BVCorr and CCCorr will be included in the data channels.

APPENDIX B QC FILTER COMPUTATION

Assume the QC filter is set to *L* seconds (usually 120 or 180 seconds). The FIR filter will be *2L+1* seconds long, with a nominal cutoff period of 2*L* seconds.

First, calculate the weights for an ideal FIR low-pass filter with cutoff at 2*L* seconds, length *2L+1*:

$$f(k) = \frac{1}{L} sinc\left(\frac{1}{L}(k - 1 - L)\right),\ k = 1,\ 2L + 1$$

The sinc function is defined as

$$\mathrm{sinc}(t) = \begin{cases} \dfrac{\sin(\pi t)}{\pi t}, & t \neq 0 \\ 1, & t = 0 \end{cases}$$

Next, calculate the weights for an Exact Blackman window of length *2L+1*. The equation for the window weights is

$$w(k) = a_0 + a_1 \cos\left(\frac{2\pi(k - L - 1)}{2n}\right) + a_2 \cos\left(\frac{4\pi(k - L - 1)}{2n}\right), \quad k = 1, 2L + 1$$

$$a_0 = \frac{7938}{18608}$$

$$a_1 = \frac{9240}{18608}$$

$$a_2 = \frac{1430}{18608}$$

Apply the window function to the filter weights:

$$F(k) = w(k)f(k),\ k = 1,\ 2L + 1$$

Finally, normalize so that the sum of the filter weights is 1:

$$G(k) = \frac{F(k)}{\sum_{i=1}^{2L+1} F(i)}$$

G(k) is the final filter to be applied by convolution.